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THE ENGINEERING DIVISION of the ORDNANCE DEPARTMENT

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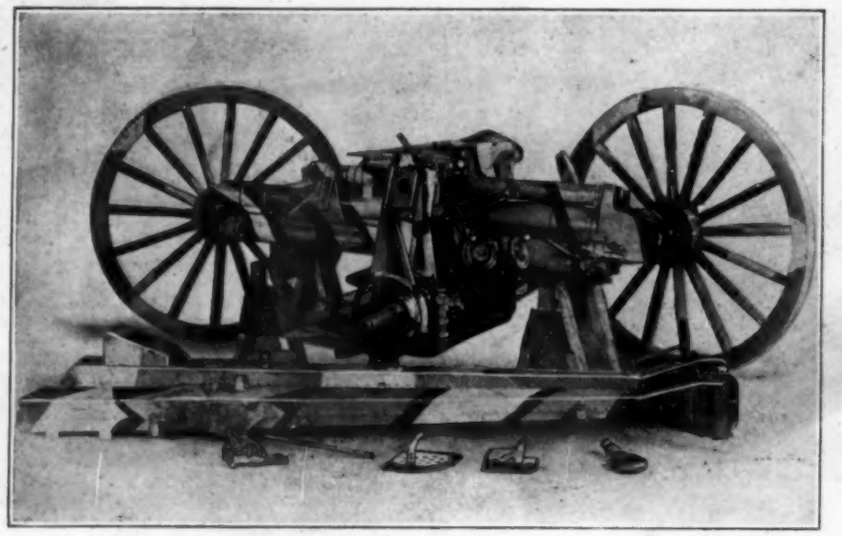
THE general public has expected American inventive genius to produce some new and fearful engine of war that would so far outclass in destructive power anything in existence as to immediately overcome all resistance. This idea is a holdover from childhood imaginings based on the "Arabian Nights," in which rubbing the magical lamp instantly caused the accomplishment of unheard-of tasks. Nowadays, science and engineering have so thoroughly explored the possibilities that practically all modern war appliances are modifications, adaptations and improvements of things already in existence. The tank, for example, is an adaptation of the "Caterpillar" tractor protected by armor and mounted with guns. Liquid-fire projectors are an adaptation of the blow torch. Airplane drop bombs are modifications of high-explosive shells fitted with modified detonating fuses. The effectiveness of any of these things from a strategic standpoint is absolutely limited by the time necessary to produce them in enormous quantities required by an enormous army. Manufacturing capacity must not be diverted to something new and untried if this diversion will reduce the flow of what has been demonstrated to be effective.

Seventy-five linear miles of blueprint, brown-print paper and tracing cloth are required a month to convey the details of our mechanical war program to the thousands of plants that are transforming these plans into iron and steel. This is a description of what some of these plans are, how they are made, and who are making them

In an ordnance mechanism of considerable complexity what is invented or designed now is not effective in war until a year from now. In the fall of 1915 Vickers, Limited, of England, designed their Mark VI, 8-in. howitzer. It required eight months for them to complete the first howitzer in their highly developed shops, among the largest in the world, and which had been on a war basis for a year. To handle all matters relating to the design, modification and adaptation of all of the mechanical weapons and most of the mechanical facilities of warfare there has been built up in Washington a Division of the Ordnance Department which is the largest engineering organization known in our history. A study of the organization chart used as a supplement, will give the reader an idea of the complexity of the work handled by the 13 technical sections of this division and by its two coördinating sections. I do not know of any better way to convey a conception of the vastness of what is being done and of the value of specialized and intelligent effort than to start by describing the work of one unit of one branch of one section of the Engineering Division of Ordnance—the unit charged with designing crates for gun carriages.

Previous to the war no special studies had been made of methods of preparing artillery material for oversea shipment. After we entered the war the demand for cargo space became so great that conditions changed materially. This led to the necessity of specialized effort to design crates and disassembling methods that would not only occupy the minimum amount of cargo space, but would be of the best shape for railroad transportation in box cars and gondolas, the most economical weight for handling on docks and which would require the least disassembling in America and the least reassembling in France. Crates and packages as originally designed by the manufacturers of the material were subjected to careful study. Information was obtained from chief stevedores, shipping boards, Ordnance officers at docks, from Army organizations and from railroads in America and France. Based on this information and resulting from the designs worked out by Maj. L. W. Chase of the Engineering Division, formerly a professor of agriculture at the University of Nebraska, in coöperation with manufacturers, Ordnance draftsmen and other Ordnance officers, astounding savings have been effected. These savings, computed on the present cubic size of crates for field-artillery material alone as against the cubic size required for the same material less than a year ago, are as follows: In railroad space from plant to seaboard, the equivalent of 2558 36-ft. gondola cars; in ship cargo space, 5,671,753 cu.ft.—the equivalent of 31 average-sized ships.



A camouflaged model 1916 75-mm. field gun "knocked down" for crating—Every gun received abroad is carefully examined to guard against sabotage. Disassembling for shipment makes this inspection easy as well as reducing the shipping space. It will not require more than 2½ hours' time to completely reassemble this gun in France

These savings are on material already shipped—not estimates of future savings. They are for one class of ordnance material only. They do not include the savings made by the Packing and Container Branch, which will be mentioned later.

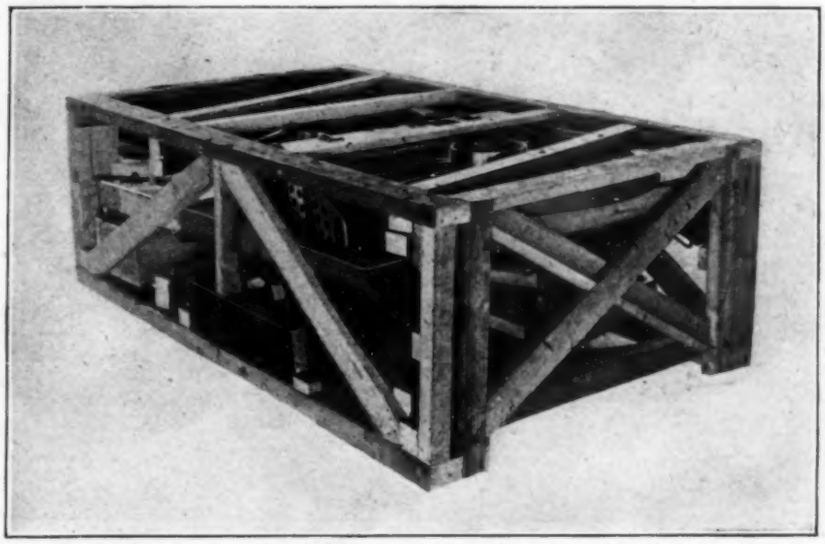
The figures in dollars and cents equivalent to the above savings, while not of as much importance as the strategic value of space itself, are of interest. The average railroad haul for this material is 600 miles. At an average freight cost of $130 a car the railway freight saving is $332,540 on this side of the ocean. Cargo space for oversea shipment will reach a minimum cost of $6 a cubic foot.[1] At this minimum rate the money saved on ocean transportation already on this one class of material alone amounts to $34,030,392.

The Germans made a serious mistake when they produced their long-range gun. As a war investment, measured by modern ordnance-engineering standards, this gun was a miserable failure. A gun of this type costs over a million dollars to produce, necessitates the design and construction of enormous machine tools, requires foundations that take several months to complete, needs special railroad-bed construction for its transportation, and when once in position is almost as difficult to transport from place to place as a cantilever bridge. Making such guns used up hundreds of tons of iron and steel that were Germany's war life-blood, and occupied months of effort on the part of thousands of mechanics who otherwise would have been employed in turning this vast quantity of steel into mobile guns. When in position this gun required a small army of attendants to operate. It was good for perhaps two hundred shots, after which it had to be taken to the Krupp works and relined on account of the erosion of the barrel. Its purpose was to send a projectile weighing about 220 lb. a distance of 72 miles. At such a distance the dispersion of successive shots is so great that no target smaller than the city of Paris could have been hit.

A bombing airplane costing less than one hundredth part of the cost of this gun and requiring but two men to operate can carry a 1000-lb. high-explosive bomb having a decidedly superior demolishing effect. It is not limited to a 72-mile range, but can place this missile accurately a hundred miles back of the enemy's lines. It does not have to be relined or carried on special railroads, nor does it require foundations. It is the essence of mobility. If captured by the enemy it represents a loss of perhaps $25,000 as against $1,000,000. "Never send a man to do a boy's work" is a sound motto in ordnance engineering. The diversion of German capital, of skill and steel occasioned by the desire of the German ordnance to obtain a transitory sensation was a very serious mistake, the effect of which no doubt partially contributed to their subsequent reverses.

[1]Figures obtained from Embarkation Service.

The science of exterior ballistics, which determines where a projectile will hit, is one of the very highest branches of higher mathematics. On guns of long range it includes taking into account the rotation of the earth during the period of flight, the curvature of the earth, the decreasing density of the atmosphere at the high points of the arc of flight, the weight, shape and center of gravity of the projectile, the air friction due to linear flight and rotation of the shell and many other involved factors. No one but a mathematical genius ever becomes a real ballistician, the work of whom is of extreme importance because from his calculations data are secured for designing new guns and for improving the range of old ones through improvements in projectiles.



How our field artillery is crated for shipment to France—This shows the gun on the opposite page crated and ready for boxing. The scientific study of this subject and the coöperation and suggestions from manufacturers have saved millions of dollars in shipping space and released hundreds of freight cars and many ships for other cargoes

Maj. Forest Ray Moulton is a ballistician in the Artillery Ammunition Section of the Engineering Division of Ordnance, and previous to the war he was a professor of mathematics in the University of Chicago. He is a member of the National Academy of Sciences, a Fellow of the Royal Astronomical Society and is recognized as one of the foremost American astronomers. What he has done in helping increase the range of American guns is shown on pages 930 and 931. The range of the gun shown has been increased 2½ miles without adding to the powder charge and with no modification whatever in the gun. Calculations led to a change in the shape of the copper driving band on the shell, which resulted in this increase.

What is more remarkable and important the variation between successive shots has been so reduced that a *given number of shots will fall into one-eighth the area formerly covered.* Think what this means in ammunition saving in reducing a fortification! This is not an isolated case, for the same thing has been done to a number of various calibers.

Improved methods of computing trajectories have been introduced by these ballisticians, so that one man can make these computations in a day, whereas last April it required 20 days to make the same calculations.

Ordnance engineering, in addition to its special requirements, differs from commercial engineering in that it must go beyond the limit of the supply of natural resources. It is seldom that a manufacturer in designing a commercial machine has to take into consideration the limited amount of common raw materials that can be produced in a given time. But in ordnance engineering it becomes necessary to adopt substitutes and to utilize every means that the ingenuity of scientists and engineers can provide to reduce the consumption per unit produced not only of such materials as iron and steel, copper and tin, but of those less commonly thought of. The total supply of linseed oil, for example, was far short of war requirements for paint. Suitable substitutes have been discovered—not by accident, but through hard work, which assures enough paint for our war program. Tetryl, picric acid, ammonium picrate, mercury fulminate, black powder, nitro starch, nitric acid, sulphuric acid and toluol, the substitution of wood fiber for cotton—the common constituents of propellants, explosives and detonators—present problems in their enormous use which require the highest degree of chemical-engineering talent to solve. Large quantities of cotton are used in the manufacture of smokeless powder. A failure in the cotton crop or a necessary increase in the explosive program might cripple the production of this powder. This danger has been removed now because Ordnance engineers have found a suitable substitute for cotton in the form of wood pulp. This change not only makes it possible to meet our enormous explosive program, but does away with any threatened shortage in raw materials.

And so Ordnance engineers are faced not only with the necessity of learning the game while playing it, and playing it quickly, but to invent all kinds of new moves as well.

So important is this matter of raw-material supply that in the total requirements over a hundred different principal raw materials as applied to every component of ordnance must be figured by the Engineering Division to see if there will be enough to go around or whether substitutes must be adopted.

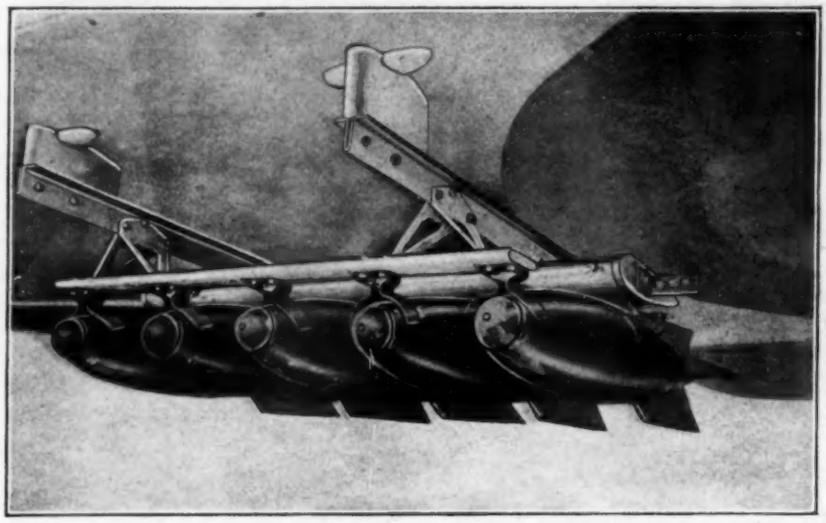
There have been four generations of the light field gun capable of throwing a shell weighing between 15 and 18 lb. corresponding in caliber to our former 3 in., the French 75 mm. and the British 3.3 in. This weight of shell gives a gun which combines mobility, rapid

fire, range and destructive effect in such proportions as to make it the most common field piece of all armies.

From Napoleon's time to 1875 the field gun was a muzzle-loading, single-piece cast gun usually mounted on a wooden axle, having a wooden trail and without recoil mechanism. When fired this gun jumped back on the ground for a distance of 25 or 30 ft. The second generation appeared between 1875 and 1885, embodying the breech-loading feature and the all-metal carriage, but still without recoil mechanism. This gun still jumped back, thus preventing accuracy of aim and rapid fire. The third generation was developed in 1897, when the French brought out their 75-mm. field piece with its hydropneumatic recoil system—the same gun that they are using and that we are making today in large quantities. This gun has a maximum range of 6400 meters, a maximum elevation above the horizontal (without burying the trail) of 19 deg. and a maximum traverse (without moving the wheels) of 6 degrees. In 1916 our Ordnance Department brought out a split-trail field piece of 3-in. caliber equipped with spring-recoil mechanism similar to that used today by the British, the Italians and the Germans. This gun had a maximum range of 8400 meters, a maximum elevation (without burying the trails) of 53 deg., and a maximum traverse (without moving the wheels) of 45 deg. Realizing the possibilities of the French hydropneumatic recoil system as applied to a gun of this type an American Ordnance officer was sent abroad to investigate it. On the basis of his report one of the foremost French designers of hydropneumatic recoil systems—a man who had been one of the principal designers of the Puteux recoil system (used on the present French 75)—was employed to design a hydropneumatic recoil for our American 1916. This was started previous to our entry into the war. The final experiments and tests on this type of American 1916 light field gun, changed in caliber from 3 in. to 75 mm. and equipped with this new design of hydropneumatic recoil system, were completed in France a few months ago. Many thousands of rounds were fired on a French proving ground before a French military commission. As a result the French have advised that on future contracts the manufacture of their famous 75 be abandoned and that we proceed to make instead our American 1916 split-trail 75 fitted with this new recoil mechanism. Here then is the fourth generation of field gun, and here also is a striking tribute from French artillery experts to the ability and initiative of American Ordnance designers.

There is a popular belief that if the United States adopts a foreign gun, such as the French 75 for example, that all that is necessary is to distribute copies of the original French drawings to manufacturers and let them begin work at once. Men who are familiar with machine-shop practice know how ridiculous such an assumption is, but even comparatively few of the well posted are aware of what is necessary in order to make a foreign type of gun suitable for American manufacturing methods.

Least of all of the problems is the conversion from metric to English measurements, and yet this presents its difficulties where in a set of drawings, a set of sample gages and an actual gun itself it is found that in many instances a dimension as measured on the gages submitted differs from that of the sample gun and again differs from that shown on the drawings.



Demolition bombs suspended beneath the wing of a bombing plane—An equal number of similar bombs are carried under the opposite wing. The destructive effect of such bombs is tremendous, as half of their entire weight is composed of TNT or other high explosives. They can be dropped "safe" when making an unexpected landing

Tolerances are as a rule lacking on French drawings. Due to this, when there are a succession of metric dimensions giving a metric total, the translation of these dimensions into English measurement brings up a perplexing problem. Either the English subdimensions must be carried out to five or six decimal places (which is bad shop practice) or enough tenths of thousands might be dropped which may accumulate an error in the total that may seriously affect the fit of the piece.

The big problem is to make use of the tremendous asset of nationally standardized machine and tool equipment through which American shops have become world famous for quantitive production and for largely eliminating hand fitting.

American practice, for example, is to use a standard-sized reamer to make the finished size of the hole and to obtain any variation necessary in the tightness or looseness of the fit by varying the size of the entering shaft or spindle. Both the French and British some-

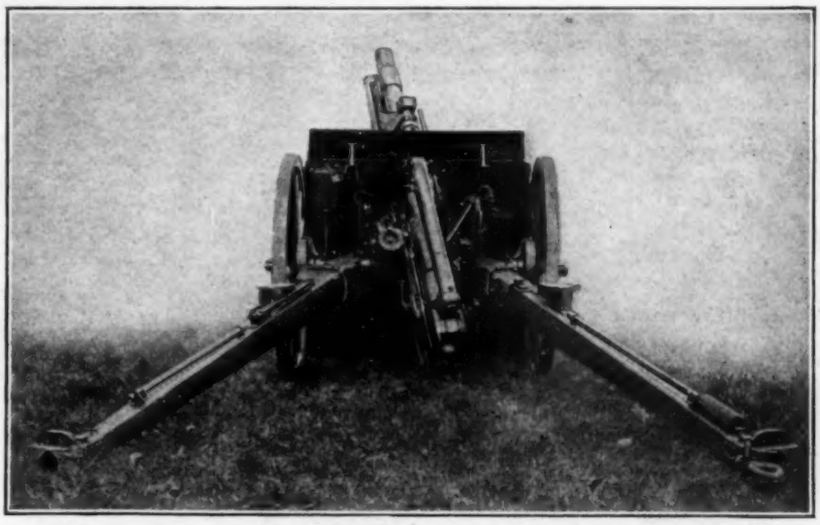
times use this practice, but as frequently make the shaft size standard and obtain the necessary fit by varying the hole. We have good reason to believe that our one way is the right way; but leaving this aside altogether, if we adopt the French dimensions and limits, which are set in accordance with their varying manufacturing policy, we at once throw out of commission all of our standard reamers, of which every good shop in America has its set, which enable a hole to be accurately sized in a few moments by comparatively unskilled labor.

We have our American standard involute gear cutters—hundreds of thousands of them distributed in machine shops from Maine to California. No American shop would undertake the difficult task of making its own cutters for gear teeth when American cutters can be ordered like hardware by standard numbers. The French gear-tooth system is entirely different. If the French system of gears as shown on their drawings is adopted it means waiting months for a supply of cutters. If we adopt our own involute system of gears it means in nine cases out of ten a shifting of the center distances between the gears, which in turn necessitates the relocation of shafts, which means practically the redesign of the mechanism. Better to take a month's time if necessary to make this change in design than to tie up production by giving American shops something they are not equipped to make. This same thing also applies to American standard thread-milling hobs.

American screw threads are almost universally cut with standard taps and dies based on the United States Standard or modified form. There are eight varieties of screw threads used by the French, including the German Lowenhertz standard, and comprising four different thread angles. Our structural-steel shapes, such as are used in gun carriages and elsewhere, are rolled to established American standards. If we adopt foreign design in toto we turn our backs on the steel shapes in stock and wait for the mills to obtain special rolls and turn out special shapes, a matter of utter impossibility under the present conditions of steel supply. The American system of rivets and rivet spacing is standardized. And so on almost without limit. American experience of the past 20 years has built up an asset of standardization of facilities that it would be criminal for an American Ordnance engineer to overlook.

Thus it will be realized that the adaptation of a foreign design to American manufacturing methods is almost as difficult as the original design itself. The drawings received from France showing the complete details of their 1897 75 with its tools, gages and accessories numbered over 2000. Due to a complete lack of perception by the public of the foregoing Ordnance engineers have been severely criticised for attempting to improve French designs. This is absolutely unjust and without foundation. No attempt whatever was made to improve upon these designs, either in the case of the famous 75 or the other adopted types. They were put into production in a form as close to the original as possible. Modifications originating in the Ordnance Department were made solely to make it possible for American shops to use their equipment and to correct a few obvious errors in the French drawings. The adoption of foreign types of guns was for the sake of expediency, as was the adoption of French calibers. The French 1897 75 was chosen as our standard light field piece because it had received the actual test of warfare, whereas our own split-trail 1916 had not. It was the "gun that saved Paris." Its adoption was a sound piece of judgment on the part of American Ordnance, and makes the recent recognition by the French of the superior qualities of the split-trail American gun all the more emphatic. The British 18-pounder field gun was adopted because British orders had built up manufacturing capacity in this country and it was sound judgment to make the most of existing facilities. The caliber of this gun was of course changed to 75 mm. The British Vickers 8-in. and 9.2-in howitzers were adopted because there was need for guns of these sizes and because one of our large steel companies had developed shop capacity on British orders. Our own 4.7-in. gun was adopted in its existing caliber because there was no equivalent French gun and because it had had a thorough service test in this country.

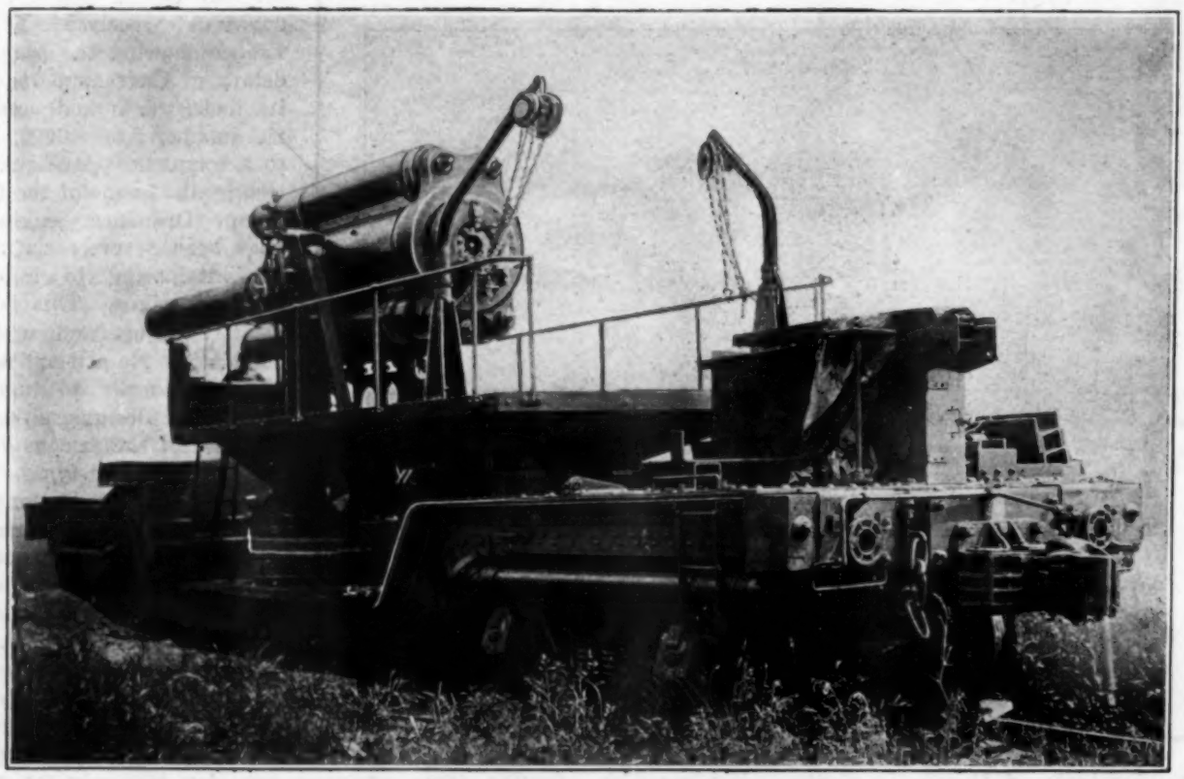
On the other hand our 6-in. howitzer, model 1908, was abandoned in favor of the equivalent caliber French gun, the 155-mm. Schneider howitzer, because it was



The fourth generation of field guns—An American development—This shows the American 1916 split-trail 75 in the position of maximum elevation and extreme left traverse. This gun, equipped with our new recoil mechanism, has been pronounced by the French after extended tests by their officers to be superior to their famous 75

recognized that our 6-in. howitzer did not have sufficient range for the conditions existing in France. No 6-in. American field gun (as distinguished from the 6-in. howitzer) existed, because road conditions in the United States were such as to prohibit the use of a gun of this caliber on a wheel mount. There was under test a new experimental 6-in. howitzer, but it was not considered sufficiently developed. So the French 155-mm. Filloux gun, model 1918, of equivalent caliber was adopted, a gun, by the way, that is a big brother to our 1916 75, having a split trail and wide traverse, and the guns are accompanied by other railway cars, each especially designed by American Ordnance engineers to perform special functions. One, for example, contains the projectiles and powder charges; another is a complete machine shop containing a motor-generator set and electric-driven machine tools for immediate repairs, while another contains spare parts and replacements.

In a test made some time ago of one of these American railway guns successive shots were fired at intervals of less than one minute. In less than 15 min. after the last shot was fired the locomotive was pulling gun, machine



One of our own railway mounts ready to go "down the line"—This is an 8-in.-caliber gun, one of the smallest of our railway mounts. It can be fired in any position relative to the track, even at right angles to it. The platform swivels through 360 degrees. Engineering skill of a high order is required to design this sort of ordnance material. Mechanical skill and shop facilities of the best grade are required for its construction

one gun of new design which the French have brought out since the beginning of the war.

American Ordnance engineers are not making the mistake that the Germans made in the matter of big guns. Exclusive of antiaircraft guns ours are of two classes, both of them highly mobile. Calibers up to 8 in. are in general mounted on wheel mounts drawn by tractors or are themselves mounted on tractors. The 8-in. and larger calibers (with the exception of the Vickers-type howitzers, which we are building and which are platform mounts) are mounted on and fired from specially designed railway trucks suited to the French roadbeds. In this way guns of the heaviest caliber are made highly mobile. The best engineering talent from the railway field has been applied to the design of these American railway guns and howitzers. These railway shop and supply cars down the track. The heaviest railway mount of American design, with its gun, weighs close to one million pounds. Any of these guns can deliver its fire, "pull stakes" and be miles away before the enemy gets his range. They are wonderful examples of the highest type of engineering skill. Absorbing a "kick back" of 7,000,000 lb. due to the recoil of one of these monsters is an engineering problem in itself of no mean order.

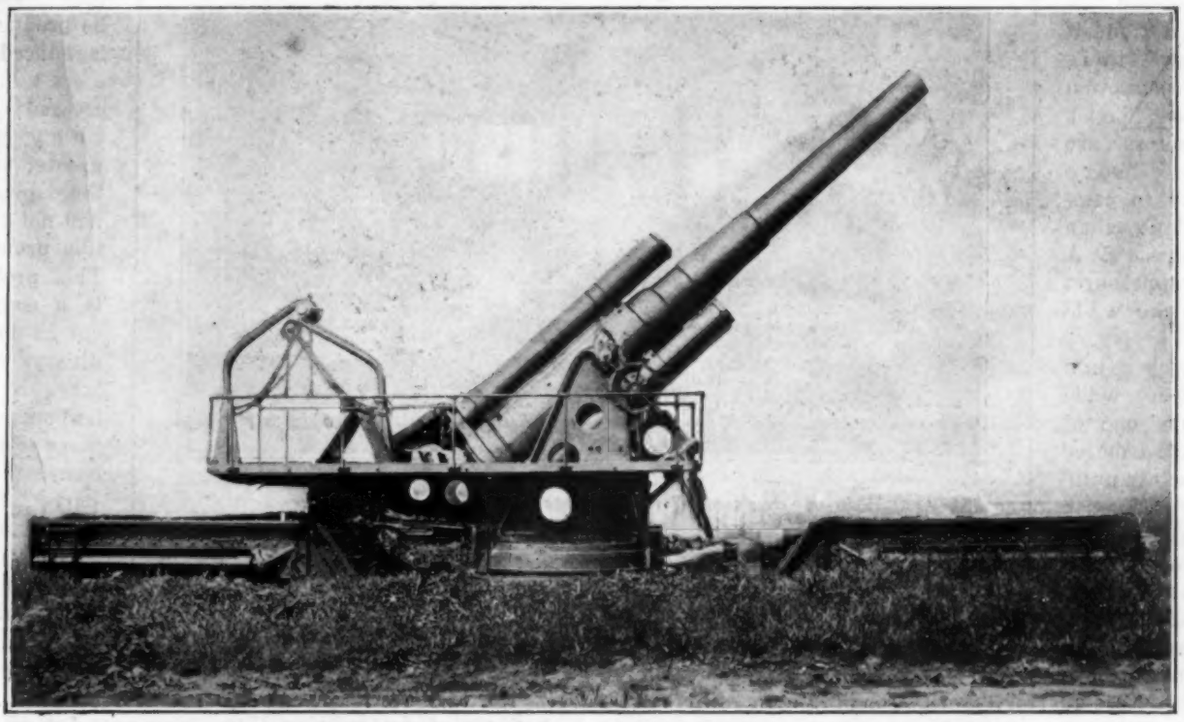
The drive which carries our boys through to Berlin will be made possible through the motorization of heavy equipment. Infantry advances cannot be made faster than artillery can follow to consolidate the gains, nor can heavy artillery advance too far beyond the necessary shop facilities for its repair and maintenance. The work of the motor-equipment section of the En-

gineering Division of Ordnance is to design motorization so that in the big drive men and guns and machine shops will move forward at their respective distances, but at the same pace.

In addition to tractors for motorizing artillery, of which there are five sizes of "caterpillars" varying from 2½ to 20 tons, our Ordnance engineers have produced ammunition trucks with steel-box bodies for the transportation of ammunition, passengers, wireless equipment, fuel, oil, water, baggage and rations. An equipment-repair truck has been provided containing bins and drawers for parts and materials for the repair of personal equipment, small arms and leather equipment. Artillery-repair trucks carrying a complete light machine shop for field repairs have been designed and are being provided, as are also artillery-supply trucks which carry spare parts for artillery and motor material.

One of the most interesting developments is the design of mobilized heavy-artillery repair shop, in which the heavy machine tools are carried on special trailers. A group of various trucks and trailers forms a veritable portable machine shop, including power plant and blacksmith department. A complete mobile shop unit includes an air compressor, with air hammers and air drills; a toolroom truck carrying a full equipment of small tools, toolholders and attachments, a keyseating machine, bench grinder and universal tool and cutter grinder. Another truck forms a woodworking shop, carrying a circular saw capable of ripping 8-in. beams, also an arbor press. Still another forms a shop office. Then there are additional trucks for heavy or bulky spare parts, for complete assemblies such as motors and transmissions, trucks suitable for carrying the personnel of the shop, trucks for carrying personal baggage, and others for gasoline and oil.

One trailer carries a No. 2A B. & S. universal milling machine, a 9-in. Seneca Falls lathe, a precision lathe and a bench-type sensitive drill. Another trailer carries a 16-in. Gould & Eberhardt shaper and a 22-in. Barnes upright drill. Another carries an 18-in. by 10-ft. Lodge & Shipley lathe and a small arbor press. Another trailer is fitted up with complete welding apparatus with a full set of torches and generators. This trailer also carries a complete blacksmith-forge equipment. Still another trailer is fitted up as an electric power plant, with a gasoline-engine-driven generator and a complete switchboard.



The 8-in. American Railway Mount at maximum elevation—In this position this gun will throw its projectile approximately twenty miles. The recoil is taken up by the pistons of the four recoil cylinders, which resemble smaller guns in outward appearance. A gun of this kind will fire its shot, "pull stakes" and be away before the enemy's airplanes can get its position and wireless this information to its artillery

The Engineering Division was fortunate in securing the services of Pliny E. Holt, vice president of the Holt Manufacturing Co., father of the "Caterpillar" tractor and grand-daddy of the tank. Mr. Holt is one of Colonel Dillard's executive assistants and is the consulting expert on motorized artillery. Over 2½ years ago Colonel Dillard and Mr. Holt conceived and designed the first heavy-gun caterpillar mount in which the gun was fired from the mount.

Few people realize that the motorization of ordnance material, in addition to vastly increasing the ease of

movement, also effects important savings in men, animals, feed, ocean tonnage and railway facilities. The motorization of one 155-mm. howitzer regiment saves 1440 horses. One tractor for this howitzer is the equivalent of 16 heavy draft horses and 3 riding horses, and yet it is so compact in its packing that it occupies but 360 cu.ft. A horsed regiment of this caliber consumes daily 29,400 lb. of forage, whether the animals are at work or idle. The same regiment with its equipment motorized consumes but 8000 lb. of fuel, oils and greases when moving 50 miles, which represents a two-days' march for such a command. In addition it stops this consumption when idle. Tractors are far more easy to camouflage than horses. A shrapnel burst which will kill every horse in a battery will leave one of these armored tractors uninjured. Trench warfare in France calls for trench-warfare engineering in America. For this close-quarter work comparatively short-range projectiles are needed, carrying a maximum destructive effect. These are required in such enormous numbers as to necessitate the most difficult sort of engineering, namely that which results in simplicity of manufacture. For extremely short range we have the hand grenade—high explosive, gas, and incendiary—with a maximum range of about 75 yd. Rifle grenades fired from special dischargers fitted to the barrel of service rifles and impelled by the gas pressure of a service cartridge fill in the range gap between the hand grenade and the light trench mortar. Intermediate calibers of trench mortars lead up to the giant which throws a shell weighing 180 lb. and carrying some 90 lb. of high explosive well over a mile. To discharge these projectiles highly specialized fuses have been designed, varying from the detonator of the hand grenade, which causes explosion 5 sec. after it has left the thrower's hand, to impact fuses which will detonate and explode the heavy-mortar bombs either before or after they have penetrated the earth, according to the effect desired. Some of the smaller trench-mortar bombs tumble during their flight, which necessitated the design and development of a detonating fuse that would act no matter how the projectile landed.

Every night in France sees a display of fireworks comparable to that of our 4th of July in America. But they are not ordinary fireworks. Parachute-suspended illuminating lights thrown by rockets and burning for 30 sec. with 400,000 cp. require pyrotechnic engineering of a high order. The design and development of these and numerous other highly specialized illuminants and signals is one of the functions of the Trench Warfare Section of the Engineering Division of Ordnance.

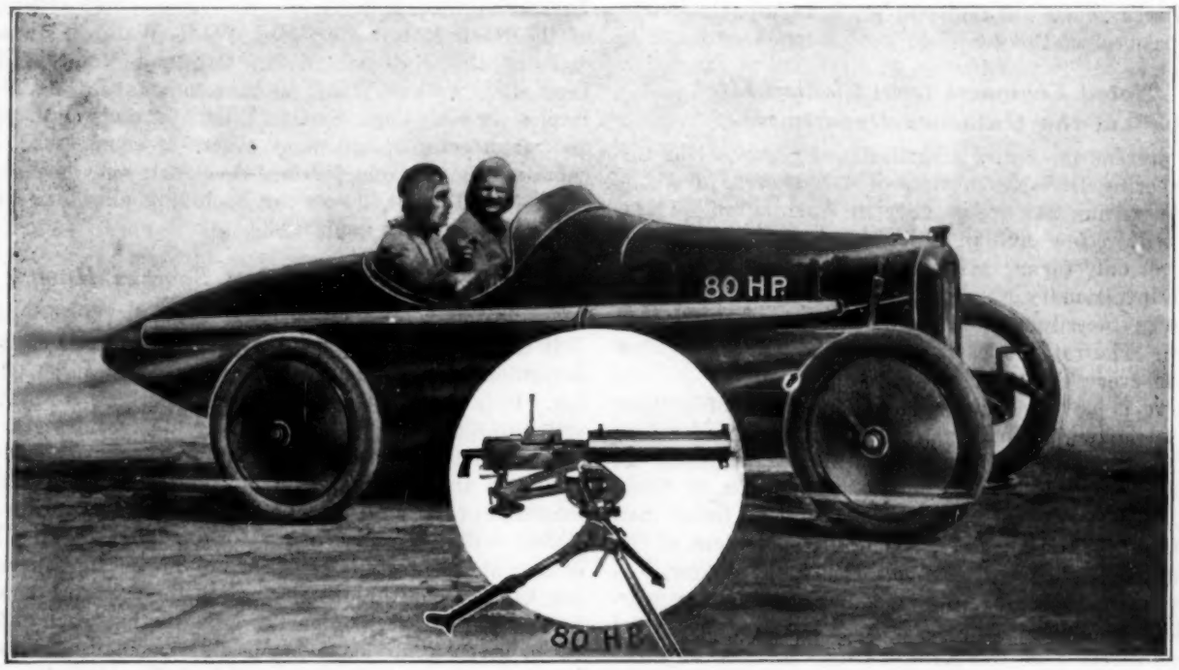
As is well known to machine-shop men the fixing of tolerances on the various parts to be manufactured and gaged is not only one of the most difficult phases of manufacturing, but it is also one of the most important. If tolerances are less than they should be production is reduced and cost increased; if they are greater then the product will not function properly. This problem is a complex one in the ordinary factory, but it becomes much more so when component parts of an assembled article are made in different shops, as are cannon, carriages, shell, fuses, cartridge cases, primers, etc. The duty of determining these tolerances for all ordnance material rests upon the Gage Section of the Engineering Division. This section, headed by Lieut.-Col. E. C. Peck, formerly superintendent of the Cleveland Twist Drill Co., must pass upon every drawing issued to American shops and determine the proper tolerances for each dimension of every component. When it is considered that the live material handled by the Ordnance Department runs considerably over 50,000 items it will be realized that this section is kept busy.

Women "draftsmen" in the Gage Section of the Engineering Division—The scarcity of draftsmen and the great need for them in Ordnance engineering has made it necessary to use women for work not requiring mechanical experience. There are approximately 400 draftsmen of both sexes in this division doing excellent engineering work

For every dimension gaged a maximum and minimum gage must be provided. Six thousand different gages had to be designed for our requirements of artillery ammunition alone. Over 60,000 master gages are required for American machine shops producing artillery ammunition, and in addition to this 600,000 inspector's gages and over 1,000,000 working gages. Besides these as many more are required for cannon, carriages, trench-warfare material, machine guns and small arms, motor equipment, optical instruments, etc.

As a striking illustration of the enormous scale on which Ordnance engineering activities are carried out, and also of the remarkable expansion of these activities within the past 12 months, the production of Ordnance blueprints, brown prints and photostats may be cited. One year ago the production of these did not

exceed 10,000 a month. During September, 1918, 370,614 prints were made in the print room of the Engineering Division, and 75 linear miles of print paper and tracing cloth a month are required. The mailing list of prints distributed to principal contractors, which is cared for by this division, covers 5000 firms. Vandyke prints are made at a cost of 11½c. each, including depreciation and overhead, as against a commercial charge for the same print of 60c. Photostats are produced on an average of 7½c. each as against a commercial charge of 35c. Blueprinting is done at a cost to



The American machine gun—the Heavy Browning—When firing 600 shots a minute this gun develops 80 hp., the equivalent of a racing automobile. The absorption of the shocks resulting from this enormous amount of energy in such a light mechanism calls for engineering ability of the highest type. Pound for pound of metal this is probably the most efficient energy-converting mechanism per pound of weight

the Government of approximately 2c. a square foot. Nowhere in commercial-engineering practice are steels and other metals called upon to resist the stresses to which they are subjected in ordnance work. Where commercial factors of safety range from 3 to 4, military necessity at times reduces them to 1.1. Lightweight bullet and shrapnel-proof steel plates must be provided for armoring guns and vehicles, and still lighter sheets for body armor and helmets. Gun erosion must be reduced to a minimum and the gun life prolonged through the proper selection, specification and preparation of special steels. This work is in the hands of Dr. George W. Sargent, who left the vice presidency of the Crucible Steel Co. to become the Chief of the Metallurgical Section of the Engineering Division of Ordnance.

Probably 99 out of 100 shots fired by artillery in this war are aimed at unseen targets. To find the desired range and set the guns to it an elaborate system of fire control is required, which necessitates many instruments of extreme precision. The optical and other instruments that accompany a field-gun battery require almost as many individual parts, or components, as a complete gun and carriage. These instruments include panoramic sights, quadrant sights, rocking-bar sights, telescopic sights, range finders, battery commanders' telescopes, aiming circles and prismatic compasses. Antiaircraft gun fire is controlled by an elaborate system of instruments to determine the altitude of the enemy's plane, its speed, direction, allowance for wind, trajectory of shell and other factors. Machine-gun fire is controlled through plane tables, panoramic sights, clinometers, Brunton transits, angle-of-sight instruments, alidades, squares, protractors and special rulers. All of these devices are designed by Ordnance engineers who, in addition to their work of design, were required of necessity to assist in the development of the manufacture of optical glass in America, practically an unknown art in this country before the war, so that material for lenses and mirrors required in enormous numbers could be obtained.

One of Colonel Dillard's many big jobs is to maintain a constantly shifting organization in a state of equilibrium. The American Expeditionary Forces are continually requesting trained Ordnance Engineers for special duty abroad. A cablegram will be received calling for the immediate embarkation of 10 Ordnance officers familiar with machine-gun design, two ballistic experts, one officer who is a specialist on antiaircraft fire-control instruments and three proof officers. The proof officers can be taken from the proving grounds,

but the remainder of these experts can come from but one place—the Engineering Division. If not supplied within 24 hours by this division the Personnel Section makes the selection from its data. This is a matter of military necessity understood by all, and it is a matter of pride with all divisions to send their best to Pershing. But imagine the difficulties of maintaining a stable engineering organization under these conditions. What would it do to your plant, for example, if half of the best men in one or two of your highly specialized departments would be taken out on 24 hours' notice and you were required to train specialists to take their places? Bear in mind that this is not an exceptional occurrence, but that scarcely a week passes without a request of this kind.

Noted Engineers from Civilian Life in the Ordnance Department

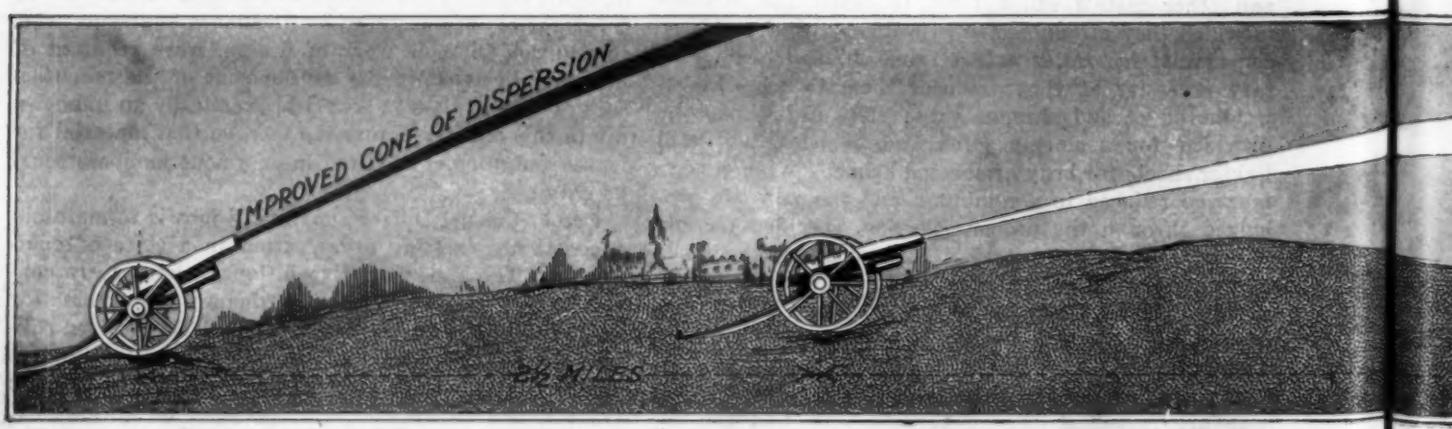
At present the entire commissioned personnel of the Engineering Division consists of 414 officers, of whom at this writing 241 are on duty in Washington. These men, with a few civilian experts and some 500 draftsmen, not only form the source of supply for the American Expeditionary Forces Ordnance engineers, but also do the engineering and designing for over a million producers. The ratio is less than one engineer and draftsman to every thousand producers.

There is no existing corporation capable of getting in its employ the aggregation of distinguished talent that the Chief of Ordnance has in his organization. In the Engineering Division alone, in addition to those mentioned elsewhere in this article, will be found men like Lieut.-Col. Herbert W. Alden, vice president of the Timken Detroit Axle Co.; Lieut.-Col. R. K. Askew, formerly secretary of the Askew Saddlery Co., former president of the Wholesale Saddlery Association of the United States, director of the Kansas City Chamber of Commerce, etc.; Maj. John H. Barr, chief engineer of the Remington Typewriter Co.; Maj. E. D. Campbell, construction engineer of the American Car and Foundry Co.; Maj. Bashford Dean, armor expert and curator of the American National Museum of Art; Maj. Howard H. Elder, superintendent of the Stevens Arms Co.; Capt. Arthur W. Ewell, professor of physics, Worcester Polytechnic Institute; Maj. L. A. Fischer, Chief of Division of Weights and Measures, United States Bureau of Standards; Capt. Albert E. Guy, formerly chief engineer of the DeLaval Steam Turbine Co.; Maj. William T. Hensley, consulting engineer and manufacturer; Maj. G. F. Hull, professor of Physics, Dartmouth College; Capt. James F. McKinnel, superintendent of the smokeless-powder plant of the British Chemical Co.; Maj. W. D. MacMillan, assistant professor of astronomy, University of Chicago; Maj. Joseph H. Matthews, associate professor of chemistry, University of Wisconsin; Lieut.-Col. Alton S. Miller, vice president of the Bartlett Hayward Co.; Lieut.-Col. H. W. Reed, public utilities engineer of J. G. White & Co.; Maj. Albert C. Schultz, chief engineer of the Mercer Automobile Co.; Maj. Christian G. Storm, directing chemist of the Ætna Explosives Co.; Maj. N. E. Wahlberg, chief engineer of the Nash Motors Co.; Maj. W. G. Wall, vice president of the National Motor Car and Vehicle Co.; Lieut.-Col. Arthur Wass, superintendent of the Ætna Explosives Co.; Capt. Samuel Wiley, pyrotechnic expert and manufacturer, and many others of equal note. As captains, majors and lieutenant-colonels they are paid from $3,000 to $4,500 a year, including allowances for "commutation and quarters."

Some Remarkable Cost Savings Have Been Made

It is difficult to separate the savings made by capable designing from those resulting from shrewd purchasing. It is safe, however, to credit the Engineering Division of Ordnance with the cost savings resulting from substitution of materials or simplification of design. Many of the ideas emanated from suggestions from manufacturers and contractors who are working so closely with Ordnance as to form a part of it. The dollars and cents thus saved are of importance in making Liberty bonds more efficient in their buying power, but of far greater importance is it that each dollar saved gives us at least one productive man-hour more with which to speed up the making of various types of war material.

Substituting crimped metal fastenings for the leather lanyards of the revolvers of enlisted men cut their cost sufficiently to save over $785,000; the idea was obtained from a negro messenger's suspender fastenings. The substitution of etched metal scales for engraved celluloid scales on deviation boards shown in the French designs saved $36,000. The design of a special battery-charging switchboard for ordnance storage batteries



Showing how modern ballistic study increases the range and accuracy of our guns—Improvements as shown cations, etc. Eight times as many shots will hit the target with the new shell

cut the cost sufficiently below the nearest standard commercial article to save $30,000. Modifications in the design of star and parachute signaling cartridges, used in enormous numbers, saved over $1,000,000. The elimination of hand fitting through the design of proper gages and the correct assignment of tolerances to the parts saved $600,000 on one contract. The substitution of antimony for tin in the slugs of the 30-caliber bullet not only helped to relieve the tin shortage, but saved $5,000,000 in money.

Millions Saved for the Government and Taxpayers

The simple matter of substitution of Parkerized steel cartridge clips for brass clips saved $1,000,000. The redesign of nonexpendable small-arms ammunition boxes saved $4,250,000. By designing a new machine-gun tripod of superior type $12,750,000 was saved. A saving of $600,000 was obtained through the redesign of a machine-gun cart. Seven thousand tons of special steel were saved in chlorine and other poisonous-gas containers through a capable design which not only avoided a shortage of that steel but saved $1,000,000 as well. The substitution of a web chin strap for leather on helmets saved $140,000. Increasing the thickness of helmet steel by 0.002 in. enabled the contractor to draw the helmet in one operation instead of two and made a net saving of $80,000.

The design and adoption of the Browning heavy gun, which is the fighting equivalent of the Vickers machine gun, not only gives our boys the most dependable weapon of its kind in the world, but saved $75,000,000 (*seventy-five million dollars*) on present contracts. This figure is based on the difference in cost to Uncle Sam of the Browning and the Vickers—the latter at a price representing the cost of the Vickers after having been in war production for three years. The design and adoption of the Browning light rifle gives us a decidedly superior weapon of that type and saved $12,750,000.

Eighteen Months' Old Organization Earns Expenses in Perpetuity

These savings are actual demonstrable savings on present contracts. Those which have been recited in this article fall far short of representing the total savings made through capable design, yet they reach a total of over one hundred and fifty million dollars. The man-power savings resulting therefrom are sufficient to release 60,000 men for active service or for additional war work. The interest alone on this sum at 5 per cent. is sufficient to pay the total running expenses of the Engineering Division of Ordnance *in perpetuity!*

All of our machine guns—light, heavy and aircraft types—have been made to use the same ammunition employed in our service rifles. This standardization of ammunition has a far-reaching effect, for not only does it simplify the tremendous quantity production of this material at home, but it facilitates its shipment, storage and the service of supply in France. It simplifies also the reclamation of spent cartridge cases in our reclamation depots, for but one kind and size of resizing die is required to reclaim all of the machine-gun and service-rifle cartridge cases.

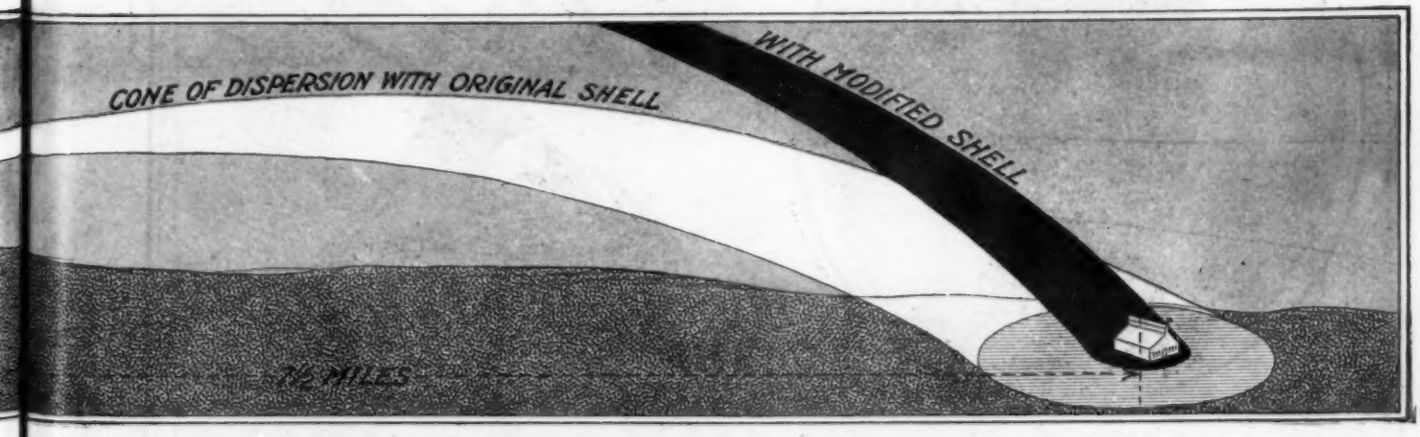
Cartridge bags for containing the propelling charges for our heavier-caliber projectiles have been made of the finest quality of silk, for no other material could be depended upon not to leave smoldering fragments in the gun after the shot, which means a burst gun and death to the crew when the next charge is inserted. Over ten thousand linear miles of this cartridge-bag cloth are required for our present program. The Engineering Division of Ordnance is now engaged in perfecting a substitute for this expensive silk, and it is safe to say that in a few weeks not only will another sensational money saving be made, but a possible silk shortage obviated.

An Incomplete Picture of a Part of the Whole

The problems, difficulties and achievements which have been presented in the preceding pages form a totally inadequate picture of a part of the activities of one division of Ordnance. From it, however, may perhaps be gained a better perception of the enormous responsibilities resting upon the men who plan the broom with which our boys "over there" will make their clean sweep. From it will be realized the necessity of keeping America's best technical talent at work where it is most unquestionably needed, and of honoring this talent for its substantial achievements.

The United States has at last become prepared by perfecting organizations such as the above.

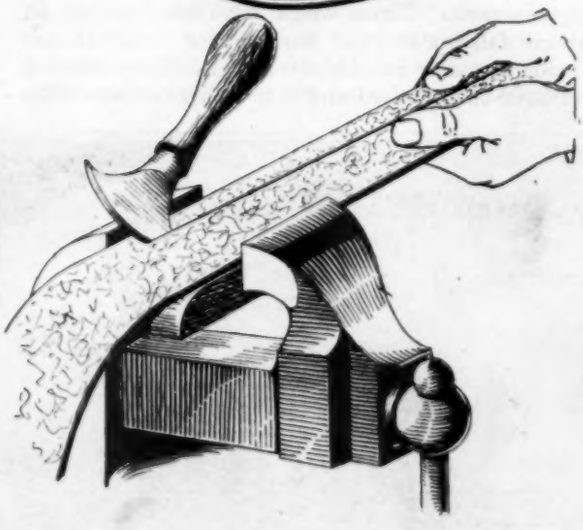
Hats off to the Engineering Division of Ordnance!



above are of great military importance. A gun of this type is used in long-range bombardment of fortifi as would hit it with the old one. American ballistic experts have made good

CURES *for* COMMON SHOP COMPLAINTS

By J. A. Lucas



American Railroad Repair Shops in France

BY ROBERT K. TOMLIN, JR.

Expecting to find everything in readiness for them on their arrival in France the United States engineers recruited from American machine shops at the last minute were informed that the responsibility of planning, equipping, purchasing and shipping the vast railway-shop project behind the lines rested upon them. Our correspondent in France narrates how with only snatches of sleep the details of this prodigious task were figured out and the work brought to fruition.

EQUIPPED throughout with American machine tools and manned by American mechanics from one of our engineer regiments the great central shops for the repair of American and French locomotives and cars, although not entirely completed, have been placed in service under conditions materially different from those contemplated when the regiment was being recruited in the United States a year ago. Our men expected to arrive in France and find shops built, fully equipped and ready to be taken over for operation by American troops, but almost on the eve of their departure overseas they were informed that upon them would rest the responsibility of obtaining and installing the entire equipment of machine tools and providing power for running them.

This news of course necessitated a sudden and complete revision of the program and a prodigious amount of rush work right up to the day of sailing. It meant the planning in detail, almost at a moment's notice,

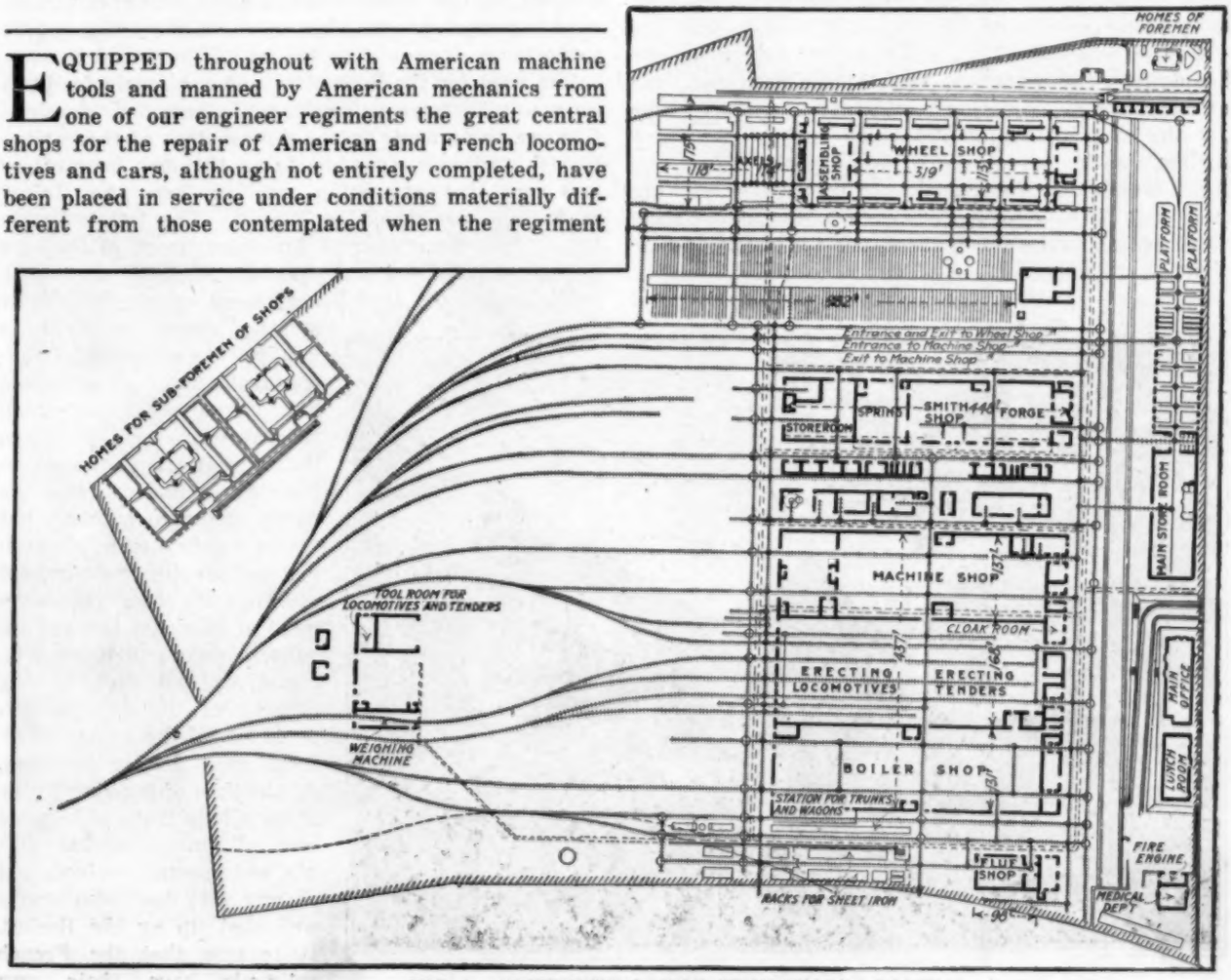


FIG. 1. GROUND PLAN OF THE SHOPS

of the entire plant layout of a huge railway-shop project, a job to which months would ordinarily be devoted. Undauntedly the officers of the regiment, all of them specialists in railway machine-shop practice, set about their task, snatching a few hours' sleep at times, until they finally embarked on their transport with the finished schedule of machine-tool equipment and its layout in the French shops and with arrangements made for its purchase and shipment. The new shops, located in the intermediate section east of the American Army area, are under the jurisdiction of the general superintendent of motive power of the transportation service, who controls all matters of standard-gage railway traffic and maintenance of equipment for the American Expeditionary Forces. A ground plan of the buildings, Fig. 1, indicates the scope of the project. Starting at one end of the site is the boiler shop, where both iron and copper boilers—the latter being common on French and Belgian locomotives—will be repaired. Next come the erecting shops for locomotives and tenders. The machine shop and toolroom occupy an adjoining bay, and in successive bays are the electric-welding and boiler-testing shops, the spring, smith and forge shops and the storeroom. After crossing an open space with tracks for incoming and outgoing equipment one comes to the axle-storage yard, paint shed, wheel shop and temporary power plant.

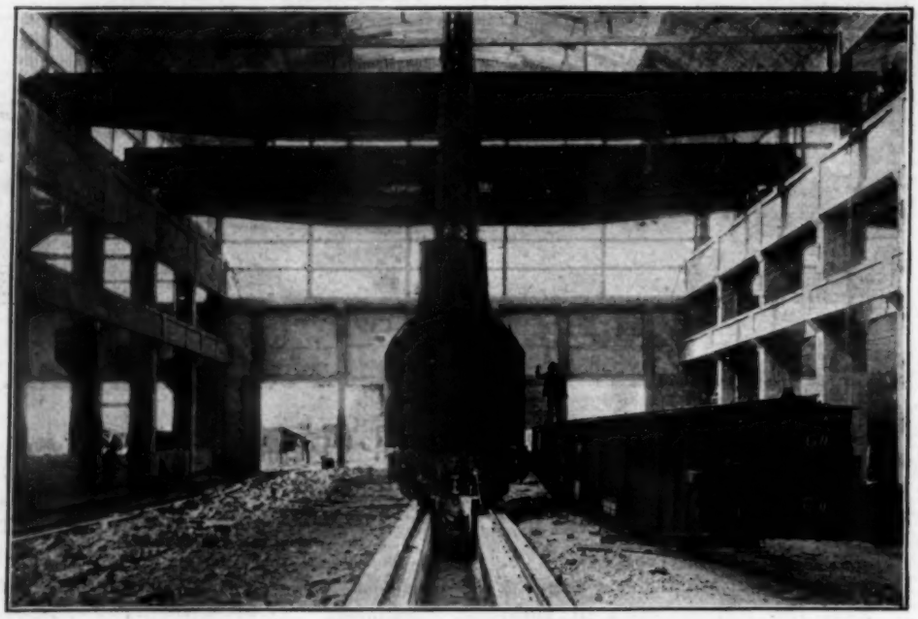


FIG. 3. PLACING OVERHEAD CRANES

At a near-by site is the car-repair yard, the general features of which are shown in Fig. 2. Here new track had to be laid and facilities provided for disabled storage, tear-down, overflow-repair, unfinished-material and finished-material storage in addition to the area devoted to the repair work proper. The car-repair yard has required about six miles of new track and 44 turnouts.

The need for the locomotive and car repair facilities is apparent when one considers the enormous demands that are being made on the rolling stock of the various French railroads, in addition to the new locomotives and cars that are being received from the United States and assembled in France. The latest figures announcing the arrival of American troops at the rate of between 200,000 and 300,000 a month give some indication of the load being placed on the equipment of the steam railways in France. As an index of railway traffic these figures mean not merely that so many thousands of men must be transported from seacoast to training ground or from one battle sector to another, but that a steady stream of material and supplies must be kept moving after them. The movement of this vast tonnage results in wear and tear on locomotives and cars, to say nothing of the damage suffered by all the rolling stock from shell fire or bombing. At the time of my visit to the shops a long train of hospital cars, all plainly marked with big, red crosses, arrived, and showed they had been pretty well shot up by the Boches. It is true that the French railroads have their own

FIG. 4. FRENCH LOCOMOTIVES IN FOR REPAIRS

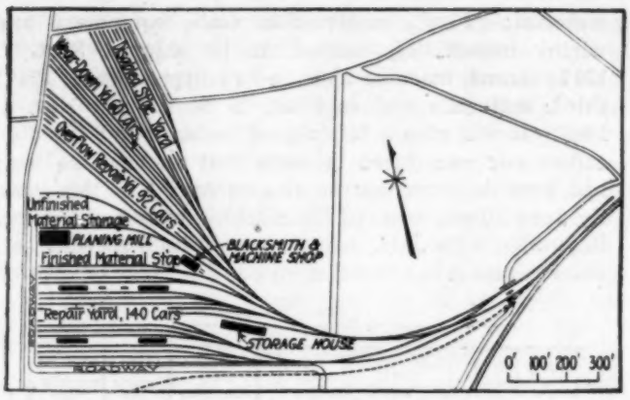


FIG. 2. THE CAR-REPAIR YARD

shops, but these have long been working to capacity, and it would have been out of the question to have depended upon them for the repair of our railway equipment. In fact the French are already utilizing our shop facilities and personnel for repairs to their own locomotives. Then too with the shipments of rolling stock we are receiving from across the Atlantic the number of engines and cars is constantly growing, not as fast perhaps as our railway-operating officials would like, but nevertheless at a rate that makes obligatory a large-scale plant for repair work.

The new shop buildings were constructed by the French. Concrete and steel forming long, parallel bays with vaulted roofs have been handled with that artistry and painstaking attention to general exterior appearance which finds no place in the design of the ordinary American industrial building. Here we have a shop, shown in the headpiece, for locomotive-repair work which might well pass for a horticultural hall

FIG. 5. SHOWING HIGH ROOF UNSUITABLE FOR BELT DRIVE

at an international exposition. Such results, however, are not achieved on a job where speed records for construction are broken, and it is small wonder therefore that the completion of the project, started by the French before the war, extended far beyond the date which it was thought the buildings would be ready for the use of the American operating force.

It was our job to take the bare shells of these shops as turned over to us by the French, equip them and

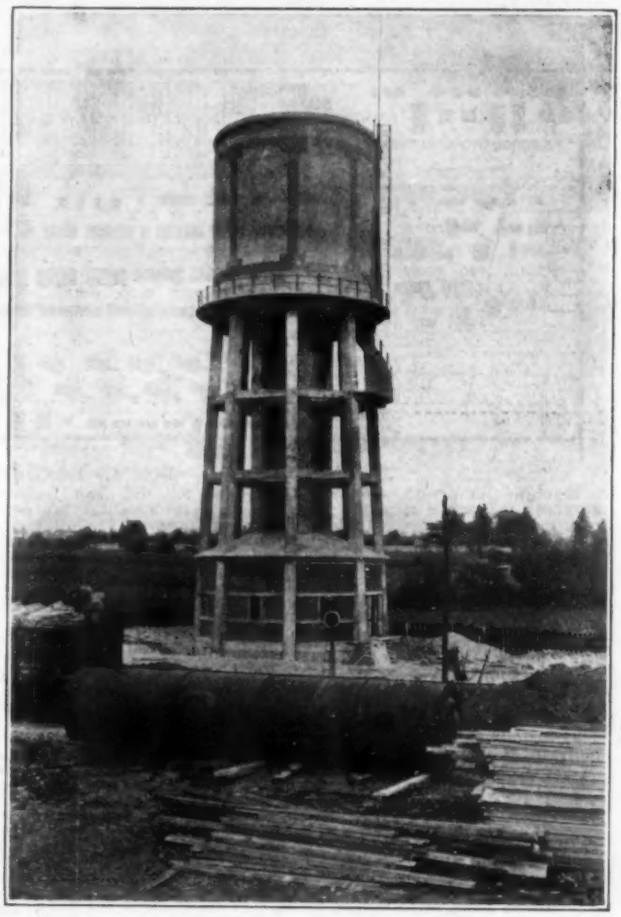


FIG. 8. THE WATER TOWER

begin repairing railway rolling stock. Pending their completion and the arrival of our own machine tools our shop regiment, organized primarily as a skilled operating force, was broken up into several units, some of them going to a base port to assemble American-made locomotives and cars and others detailed to duty at various existing repair shops of the French railroads.

This assignment of our men to work among French machines has had its advantages and disadvantages. The chief benefit has been the opportunity given to American mechanics to become familiar with French and Belgian locomotive construction, for in many features these engines are radically different from the American types. Inasmuch as our new shops will handle French as well as American work, this contact with French locomotive repairs has served to train our men to handle any sort of a job after returning to their original regiment. As to the disadvantages, our men, having been working with mechanics who are accus-

tomed to go at things in a more leisurely manner than is common in America, may become influenced in this respect, though it is somewhat early to form an opinion as to the extent of this influence on them. A big difference in working conditions is that all of our machinists are enlisted members of military units and under military control, while such conditions do not obtain in the French shops.

The problem involved in getting the shops equipped and in operation was explained to me at some length during a conversation with the general superintendent of motive power, a colonel of engineers who is in command of the railway shop regiment. According to the original schedule, the buildings were to have been completed Sept. 1, 1917, and fitted up with machine tools, small tools, air, steam and water lines and electric power. This work all was to have been done by the French, leaving nothing for our regiment but to recruit its ranks from skilled shopmen and begin operation. Subsequent events have indicated the extreme optimism of this program. The bare shells of the buildings were not turned over to the American forces until April, and the shipping crisis delayed the delivery of machine tools from the United States.

When the inventory of equipment for the shops was made up and orders were placed before the regiment sailed three phases were planned for the shipment of material: First, construction tools, equipment and wiring immediately needed, to be shipped Sept. 1, 1917; second, machine tools, to be shipped Oct. 1, 1917; third, materials and supplies, to be shipped Nov. 1, 1917. It will give a fairly good indication of the difficulties our men faced to state that no machine tools had been delivered on the site on Apr. 1 of this year. By June 20 per cent. of the machine tools had arrived. Beginning with July, deliveries have been speeding up, and equipment is now being received in large quantities.

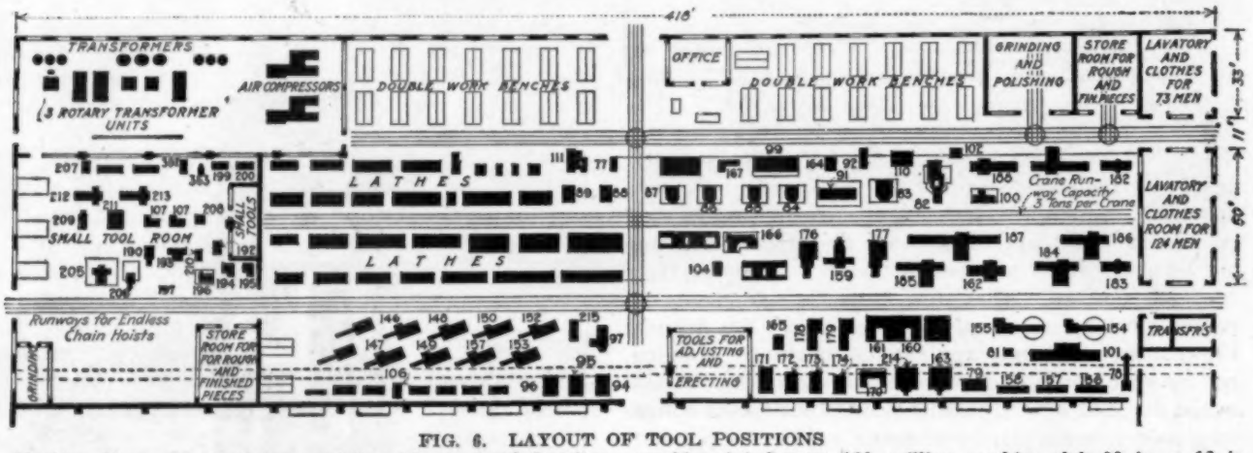


FIG. 6. LAYOUT OF TOOL POSITIONS

Machine Shop.—77, centering machine; 78, six head Lassiter staybolt threading machine; 79, four spindle Lassiter bolt cutting machine; 80, six spindle Lassiter nut tapper; 81, nut facing machine; 82, boring mill 84-in. diameter Niles; 83, boring mill 53-in. diameter Niles; 84, boring mill, 44-in. diameter Niles; 85, boring mill 44-in. diameter Niles; 86, boring mill 44-in. diameter Niles; 87, boring mill 44-in. diameter Niles; 88, vertical turret lathe 36-in. Bullard; 89, vertical turret lathe 36-in. Bullard; 90, horizontal boring machine 24 in. x 6 ft. Niles; 91, horizontal boring machine 50-in. tilt table D. & H.; 92, high speed drill press, Foote-Burt Co. 13 in. x 29 in.; 93, high speed drill press, Foote-Burt Co. 13 in. x 29 in.; 94, high speed drill press, Colburn Co. D4; 95, high speed drill press, Colburn Co. D4; 96, high speed drill press, Colburn Co. D4; 97, five foot radial drill press, Bickford box table; 98, 5 ft. high speed drill press Bickford; 99, locomotive rod boring machine; 100, grinder 60-in. guide bar Bridgeport; 101, grinder 20-in. piston rod grinder 120-in. centers; 102, grinder 30 in. x 4 in. wet tools; 103, grinder 30 in. x 4 in. wet tools; 104, grinder 30 in. x 4 in. wet tools; 105, grinder 30 in. x 4 in. wet tools; 106, grinder 30 in. x 4 in. wet tools; 109, 14 in. x 36 in. cylinder grinder, Norton; 110, 10 in. x 36 in. cylinder grinder, Norton; 111, link grinder for link radius; 112, lathe; 133, lathe, 24 in. x 12 ft.; 134, lathe, 24 in. x 12 ft.; 141, lathe, 30 in. x 18 ft.; 142, lathe, 30 in. x 12 ft.; 145, lathe, 42 in. x 19 ft.; 146, lathe turret, 2½ in. x 26 in. Pratt & Whitney; 147, lathe turret, 2½ in. x 26 in. Pratt & Whitney; 148, lathe turret, 2½ in. x 26 in. Pratt & Whitney; 149, lathe turret, 2½ in. x 26 in. Pratt & Whitney; 150, lathe turret, 2½ in. x 26 in. Pratt & Whitney; 151, lathe turret, 2½ in. x 26 in. Pratt & Whitney; 152, lathe turret, 2½ in. x 26 in. Pratt & Whitney; 153, lathe turret, 2½ in. x 26 in. Pratt & Whitney; 154, lathe turret, 5 in. x 24 in. Gisholt; 155, lathe turret, 8 in. x 36 in. Gisholt; 156, lathe gun barrel for drilling staybolts; 157, lathe gun barrel for drilling staybolts; 158, lathe gun barrel for drilling staybolts; 159, milling machine 5-B plain horizontal B. & S.; 160, milling machine 4-A heavy; 161, milling machine 4-A heavy; 162, milling machine slab 32 in. x 12 in. table planer type; 163, milling machine 3-A universal, index heads; 164, press forging machine 100 tons forging; 165, press forging machine 100 tons forging; 166, saws, power 30-in. Newton; 167, 1 combination cold saw cut off machine; 168 1 hack; 169, 1 hack; 170, shaper, 26-in. stroke, 96-in. traverse; 171, shaper, 24-in. stroke; 172, shaper, 20-in. stroke; 173, shaper, 20-in. stroke; 174, shaper, 16-in. stroke; 176, slotter 30-in. stroke drill; 177, slotter, 30-in. stroke drill; 178, slotter, 15-in. stroke drill; 179, slotter, 15-in. stroke drill; 180, surface plate, 9 ft. 8 in. x 36 in. x 4 in.; 181, surface plate, 4 ft. 8 in. x 36 in. x 9½ in.; 182, planers, 30 in. x 30 in. x 6 ft. Gray; 183, planers, 30 in. x 30 in. x 6 ft. Gray; 194, planers, 42 in. x 42 in. x 10 ft. Gray; 185, planers, 42 in. x 42 in. x 10 ft. Gray; 186, planers, 42 in. x 42 in. x 20 ft. Gray; 187, planers, 42 in. x 42 in. x 20 ft. Gray; 188, planers, 56 in. x 56 in. x 10 ft. Gray; 214, milling machine 3-A universal index heads; 215, high speed press Foote-Burt Co. 13 in. x 29 in.; 351, 42-in. drill press.

Tool Room.—190, drill press high speed 13 in. x 29 in. Foote-Burt Com. table; 191, drill press high speed 13 in. x 29 in. Foote-Burt rev. table; 192, grinder, 30 in. x 4 in. wet tools; 193, grinder, cutter and reamer No. 19 B. & S.; 194, grinder, twist drill, Sellers; 195, grinder, twist drill, Sellers; 196, grinder, universal tool, Sellers; 197, grinder, universal tool, Sellers; 198, lathe bench 7 in. x 32 in.; 199, lathe, 10 in. x 30 in. metric; 200, lathe, 10 in. x 60 in. American; 204, milling machine, 4-A heavy B. & S.; 205, milling machine, 4-A heavy B. & S.; 206, milling machine, 3-A universal index heads; 207, miller die sinking No. 60T; 208, press arbor No. 5 Greenard; 209, shaper, 20-in. stroke; 210, shaper, 14-in. stroke; 211, shaper, 10-in. stroke vertical; 212, planer, 24 in. x 24 in. x 6 ft. Gray; 213, planer, 24 in. x 24 in. x 6 ft. Gray; 107, grinder, surface mag. chuck, No. 3 Wilmarth & Norman; 108, grinder, surface mag. chuck, No. 3 Wilmarth & Norman; 352, cut off saw, No. 5 Robertson; 353, drill press, Henry & Wright.

These conditions are cited, not by way of criticism, for delays have been inevitable, but rather to convey to our engineers in the States what the building up of our shipping tonnage actually means in the progress of our engineering work over here.

The first work done at the shops was on general engineering supplies, including the erecting and repair of piledrivers, cranes and steam shovels. By June 1, however, track had been laid in the erecting shop and work was begun on placing the big overhead cranes shown in Fig. 3. By July 1, with some of the cranes in place, work was started on locomotive repairs.

On July 27, 13 locomotives, all French, were in the shops for repairs (see Fig. 4). The wide variety in the design of these machines is a complicating factor in the repair work. Nothing approaching standardization exists, and many parts are not interchangeable.

For example, the colonel of the shop regiment told me that there were 37 different types of Belgian locomotives operating on French roads, and of these our own shops have already handled repairs on 15 types. The central shops expect to receive for repair and overhauling not only all American equipment but a certain number of locomotives from such important French railroads as the P-L-M, the Paris-Orléans, the Nord, the Est, and possibly the État. Our own rolling stock, being standardized, will be handled far more easily and quickly in the shops than the wide variety of European machines in service.

At the end of July the American operating force at the shops numbered about 800, and it was expected that the rolls for August would show a total of about 1500 men, for with the buildings finished and the machine-tool installation progressing at a rapid rate the policy is to call back to their own regiment for work under the supervision of American officers the details of men which had been assigned to duty in various French railway shops.

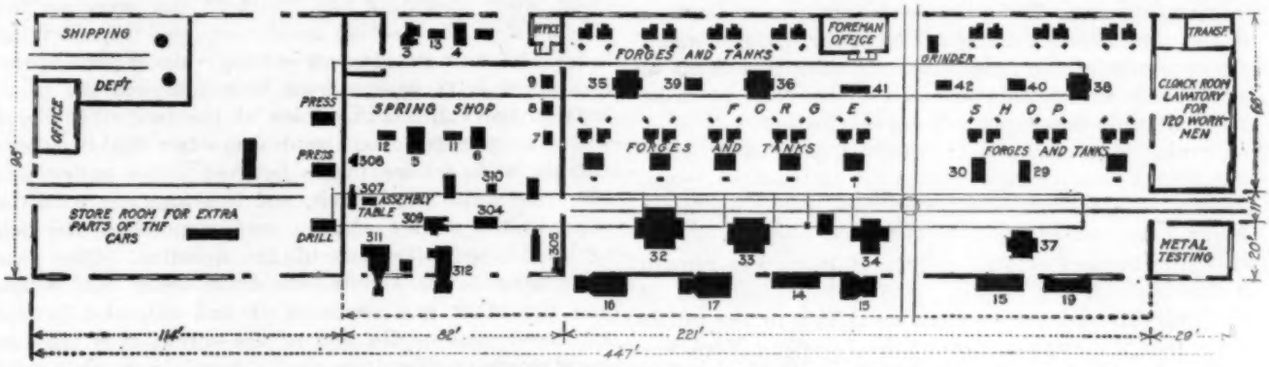


FIG. 7. PLAN OF SPRING SHOP AND FORGE

Spring Shop.—5, 4-in. Ajax forging machine; 6, air bulldozer, 18 in. x 30 in. stroke, P. R. R. standard design; 11, furnace bolt heating and tube welding; 12, furnace bolt heating and tube welding; 304, combined spring punch and shears; 305, steam-driven hydraulic pump, 1500 lb. pressure; 307, 100-ton spring banding press; 308, 35-ton spring testing press; 309, Riley spring forming machine; 310, single end nibbing machine; 311, furnace for spring drawing (lead bath); 312, furnace for heating and hardening springs; hydraulic spring stripping press.

Forge Shop.—14, furnace for annealing locomotive crank axles; 15, single door furnace for hammer work; 16, double door furnace for hammer work; 17, double door furnace for hammer work; 19, furnace for case hardening; 29, punch 18-in. throat H. & J. No. 6; 30, shears 18-in. throat H. & J. No. 6; 32, steam hammer 6000 lb. double frame; 33, steam hammer 4000 lb. double frame; 34, steam hammer 3200 lb. single frame (special); 35, steam hammer 1500 lb. single frame; 36, steam hammer 1500 lb. single frame; 37, steam hammer 1100 lb. single frame; 38, steam hammer 800 lb. single frame; 39, Bradley hammer 80 lb.; 40, Bradley hammer 80 lb.; 41, surface plate G. I. 9 ft. 8 in. x 36 in. x 4 in.; 42, surface plate G. I. 5 ft. 6 in. x 36 in. x 3½ in.

Bolt and Flue Shop.—3, 1¼-in. Ajax forging machine; 4, 1¼-in. National bolt header; 7, 2¼-in. bolt and nut cutter, single head; 8, 1½-in. bolt and nut cutter, double head; 9, 1¼-in. bolt and nut cutter, double head; 31, 2-in. shears, round iron.

The thing to keep in mind in attempting to visualize the work which has been done at the central shops is that practically everything, from small tools to big turret lathes, rolls and planing machines, has had to reach the job after a trip of more than 3000 miles. With the tremendous tonnage that is being delivered at our base ports here and handled by the various railway lines it is no simple matter to have a big shipment of machine tools reach its destination without delay or some kind of loss. Sometimes crates improperly marked are sidetracked and diverted into some of our big storage centers where they may not see the light of day again for weeks or months. Then too, in the case of a bulky machine-tool unit, parts must be packed and shipped in separate crates. If these all arrive at one time, well and good. If they do not—and such cases are not uncommon—the work of installing that particular machine tool must be held up, for it is practically impossible to duplicate missing parts over here.

Every American manufacturer, of course, is trying to help the work here in France in every way. Let him, therefore, pay particular attention to two matters connected with the shipment of machine tools. First, take rigid precautions in inspection during crating to see that not a single part necessary for the operation of the machine is missing, since replacements take months, not days; second, insist upon receiving accurate directions for marking crates to insure prompt delivery at their proper destination. When such directions are received follow them to the minutest detail. It is a big place over here, and we have scores of shops where machine tools are being installed. Unless a package is started out on its transatlantic journey complete in all parts and properly labeled all sorts of confusion and trouble result on this side. A crate stenciled with some such generality as "American Army, France," may arrive here, but what will become of it after that only some of our stevedores may know for a while and promptly forget. When so many important things are demanding the best efforts of our engineers the pastime of organizing searching parties to ferret out missing equipment is one that is not popular over here.

All of the machine tools at the new railway repair shops, as well as the big overhead cranes, have individual electric-motor drives. The type of building constructed, as shown in Fig. 5, was one ill adapted to the use of shafting and belts on account of the height of the roof. Then too a big electric central station that the American Expeditionary Forces are completing not many miles away makes electric power for running the plant available by means of a transmission line. Pending the delivery of this power, however, a temporary plant of steam-driven electric-generator units was erected at one end of the shops and has been in service for some time.

Much trouble has been experienced in obtaining flooring material for the shops. Lumber is hard to get, but this difficulty is being met by making flooring from the packing cases in which the machine tools were shipped.

As to the layout of the shops Fig. 6 shows the location of the various machine tools in the machine shop,

while Fig. 7 is a plan of the forge and spring shop. There have been a few changes from the original plans, due to the nonarrival of certain machines and the receipt of others different in size from those expected. The scheme of individual electric drive for each unit, however, offers a considerable amount of flexibility in locating the machine tools, and changes from one place to another have not involved serious difficulty.

In Fig. 8 is shown the very artistic and substantial water tower that serves the locomotive-repair plant.

A Reply to One of Chordal's Letters

By F. M. A'Hearn

Dear Chordal: When the good news was announced in the *American Machinist* that your letters would appear again in the machinist's favorite it seemed to be the only thing that remained to be done to make the best trade paper published even better.

Chordal, you conveyed the idea in your first letter that things have changed somewhat in machine shops. I admit to a certain extent that they have; but some things have not changed in the least and never will while the readers of your letters of years ago remain in the land of the living. One thing unchanged is the lively interest your letters awakened in the minds of the men who were readers of the *American Machinist* in the days before high-speed steel and "rapid-fire" lathes were heard of; also the days when articles on bicycle manufacture occupied a prominent place in the publication and when horseless carriages were just what the name implied.

Bet you the editor will "fess up" that the old files will show an idea that was advanced about that time to overcome the uncertainties of gasoline or steam automobile travel—that was a system of trolley wires along our country roads to furnish power to electric automobiles. Looked good too, you know—just like the new-fangled trolley cars that were putting the horse and cable systems into the discard.

Automobile Trolleys

Just imagine you and I going out 15 miles or so to Jones' mill to give first aid to a disabled corn sheller, the roads a little rough, you driving a well-known tin car [name censored] and I trying to keep a trolley on the wire while you hit her up to a 35-mile clip. Don't believe it could be done, do you? The gentleman in Detroit had the right idea when he built his machine with a gasoline motor and a reputation.

Remember how A. P. Prees used to tell about things that happened before our time? Of the hard-hearted job-shop foreman who cut down the old apple tree that stood just outside of the shop window and set the tailstock of the lathe on the stump in order to get a long job on the centers? And how he took the cross-rail off the planer and set it up to turn a propeller-shaft bearing on a small steamship?

When I opened the last copy of the *American Machinist* the first thing I did was to look at the index, and the next was to read about the chain-drive planer of your early days.

I met a planer several years ago that was in all probability a cousin of the one you mention. More than merely meeting it I had many opportunities to get well acquainted with it. As near as I could learn it was built by J. H. Gage, Nashua, N. H., about 1840—well built, too. It was driven by a screw supported by bearings at each end of the bed, the screw engaging a nut in a yoke, or jaw, on the under side of the table. This same nut, if the table traveled beyond the established limits, would lock or jam solidly against the end of the bearing. This would neatly and quickly remove the belt from the line-shaft drive pulley. A bar between the spokes of the drive pulleys on the machine and a moderate amount of strong language from the operator would be the usual items necessary to remove the nut from the vicinity of the danger zone. As you stood when operating the "critter" you were on the off side from the position usually occupied when driving a mule team or running an ordinary planer; the aforementioned drive pulleys were located beyond the housings at the right-hand corner of the bed. The drive was like the one you mentioned—two tight pulleys outside with a loose pulley between. The pulley was the same width as the belt, and this together with the slack in the shifter rigging made "spotting" the belt on the loose pulley out of the question. The gear arrangement was simple, one drive shaft was hollow and the other ran inside of it and extended beyond the bevel gear on the end of the screw, thus the two bevel gears on the drive shafts faced each other with the screw gear between. The table traveled at the same speed on both cutting and return strokes.

The Feed Mechanism

The feed was driven from a pinion on the end of the driving screw through suitable shafts and gears to a rocker arm on the side of the bed. A rope from this arm wound around two grooved pulleys, one on the horizontal shaft above the tie beam and the other on the cross-rail feed screw. Each wheel had a pawl to engage a ratchet on the shaft. The end of the rope was weighted.

The upper wheel apparently was provided to rotate the single cross-rail elevating screw and to provide a vertical feed by feeding the cross-rail bodily up or down, the cross-rail sliding on Vs on the housings. The feed on the cross-rail head was hand operated.

The swivel tool-block apron was not included in the makeup of the machine; the next best method on side cuts was for the operator to lift the tool clear of the job by hand on each return stroke. This also helped to keep his mind on his duties to his employer.

The kicking tendency you describe was present on long cuts and was partly overcome by piling castings on the table when the shape of the job would permit.

When there was only one planer in the shop where a boy started to learn his trade he had little chance to judge the merits of planers by comparison. I am afraid one of these old-timers would look out of place in any of the present-day shops unless exhibited in a glass case as a relic.

The next time I write I will send you a picture of a planer of grandfather's days. The maker was ashamed of it when he saw the results of his work for he did not put his name on it.

Liability in the Use of Simple Tools

BY CHESLA C. SHERLOCK
Secretary Iowa Industrial Commission, Workmen's Compensation Service

The "simple-tool doctrine," which tacitly existed in the courts for many years, held that an employer was not liable to his workman if while using a simple tool, such as a hammer or a saw, the workman was injured. This doctrine was abused so much, however, by employers seeking to prove that almost any kind of tool was a simple one, so as to escape liability, that it has ceased to be tenable, and now most courts will decide which is and which is not a simple tool.

MOST employers are familiar with the law which requires them to furnish their workmen with a reasonably safe place in which to work and with reasonably safe tools and appliances. The theory that the employer must examine and regularly inspect the tools and appliances was based upon the assumption that the employer, knowing more about these tools and appliances, should use his superior knowledge to protect the life and person of his workmen.

For a long time the courts recognized an exception to this general rule in respect to the use of simple tools. They said that if the employee was required to work with only simple tools, such as a hammer, a saw and the like, that the master was under no liability to inspect and examine them. This was upon the assumption that simple tools are so readily understood, even by the most ordinary worker, that any defect in their condition would be at once apparent and would be reported, failing to do which he would be held to have assumed the risk of their use in their defective condition.

This was known as the simple-tool doctrine and met with wide favor in the various courts for many years. But finally the courts came to break away from their former construction.

Labatt, in his work on "Master and Servant," explains the proposition clearly: "In some cases the courts have gone to the length of stating that the rule requiring the master to use ordinary care to furnish reasonably safe appliances does not apply where the injury was caused by a simple tool. In other cases it is said that the master is not required to anticipate that injuries may result from the use of defective simple tools. Again some cases say simply that the master is not liable for injuries caused by simple tools, without specifying the particular ground for the nonliability.

The most frequent application of the so-called simple-tool doctrine is found in those cases which hold that the duty of the master in respect to simple tools is not continuous, and he is under no obligation to inspect simple tools which he has placed in the hands of his servants for use. It has been held that no liability can be predicated on the master's failure to instruct a servant in the use of a simple tool.

"It does not seem entirely logical to say that the master is under no obligation to exercise ordinary care to furnish reasonably safe appliances simply because those appliances chance to be of a simple character. The more reasonable view would seem to be to place the nonliability of the master upon the ground that any defect in a simple tool must be obvious to the servant, and any risk of danger therefrom must be held to be assumed by him, and this indeed is the view taken very frequently."

Because of the opportunity presented employers in the adoption of this rule in many jurisdictions they have sought to prove almost every conceivable kind of a tool to be a simple tool and therefore escape liability from the payment of damages. In this way we have a direct adjudication by most of the courts upon specific tools and appliances so that we have a good working basis for determining the character of every specific tool commonly used.

A Floor Not a "Simple Tool"

In one case a workman was injured by a portion of a concrete floor caving in with him. He sued for damages under the Federal Employer's Liability Act and the employer defended upon the ground that the floor was a simple tool, and therefore he could not be held liable. The court was not so easily duped. It decided that it would be absurd to say that a concrete floor was a simple tool or, in fact, a tool at all.

In an Illinois case the complaining employee sued because of an injury while using a ladder. The lower court gave him a verdict, but the Supreme Court overruled it and held that a ladder is a simple and ordinary tool, the nature of which is easily understood, and when used by a servant familiar with it he is conclusively presumed to have assumed the risk of all defects therein, whether they be patent or latent, and the question of whether the employer knew of such defects or could have ascertained them by reasonable care had nothing to do with the matter.

In a federal case the workman received his injury from a chisel that another workman was holding while the injured workman was hitting it with a sledge hammer. The evidence showed that the chisel was defective in that when struck it was continually breaking off in pieces, one of which struck the plaintiff in the eye. It was also shown that properly made chisels would mushroom instead of chip off and that manufacturers used every effort to test their chisels to see that they did not chip off. The contention was made by the employer that a chisel was a simple tool and that he was not liable, although it was admitted that the workman had complained of the tool and had been told to use it or to go home. The court held, as a matter of law, that a chisel is not a simple tool and submitted the question of whether the injured workman had assumed any risk to the jury.

The Illinois court, however, in a case involving a similar fact, but in which the sledge was defective, held that the sledge was a simple tool and refused to allow the plaintiff to recover. In that case the plaintiff was holding a chisel while another was using the sledge,

the head of which flew off and struck the plaintiff on the arm.

In another Illinois case the plaintiff was employed in the defendant's shop, and when asked if he had anything to do and he replied in the negative, he was handed a monkey wrench and told to take a saw off a machine. In attempting to do this the wrench slipped off the nut and caused him to cut his finger on the teeth of the saw. He testified that had he looked at the wrench before using it he would have noticed that the screw was worn and that it would not hold unless tightened properly, and that after injuring himself he did look at the wrench and discovered the defective condition of it. The court held that the wrench was a simple tool and that the plaintiff had assumed the risk of any defects it had.

The Oklahoma court, by implication, held that an ordinary steel drill bit was a simple tool and that employers were not obliged to inspect the same.

Defects Must Be Apparent

In a Kansas case a workman had to cut out some rivets in sheet metal. Being inexperienced he procured a sledge and a cold chisel and went to work. A piece of steel entered his eye and so injured it that it had to be removed. It was shown that the piece of steel removed from the eye was tempered as was also the hammer. The jury found that the injury was caused by the defective tool.

In Wisconsin the plaintiff was temporarily employed cutting rivets off an old boiler. A tool called a punch, which is shaped something like a hammer, was used, it being held against the rivet while another employee struck it with a sledge. A piece of steel from the punch struck the plaintiff in his eye, causing the loss of sight. On being removed from the eye the piece of steel was found to fit exactly into a broken place in the punch. Experts testified that long-continued pounding on a punch or similar tool tends to harden the metal, crystallize it and cause it to chip off; that these flying pieces often travel with great velocity and that when a punch commences to bur it should either be reforged or reground in order to remove its potentiality for injury. The court held that the defendant had furnished his workman with a defective tool.

In Massachusetts, except that the plaintiff was employed in cutting rivets on a bridge, a similar case was brought up. A piece of steel that had come from the tools used in cutting the rivets lodged in the plaintiff's eye, but the court held exactly the opposite of the rule aforementioned and found for the defendant. It said that it could not hold that an employer was bound to inspect and examine simple tools to see if they were in such condition as would render them liable to chip off while being used; that that was a duty which the workman was bound to observe for his own safety, failing in which he must be held to have assumed the risk of any defects which might have been in the tools, unless he could show that he was unaware of the risk and had no means of ascertaining that such defects existed.

It is generally agreed that the burden of proof in such cases is upon the plaintiff to overcome any presumption that he was familiar with the tools, their use and the indications of defects in them. Unless he can overcome this presumption by showing that the employer himself was aware of the defect or had the means of discovering it if due care had been exercised the plaintiff will fail in his action.

And this seems to be true, regardless of whether the rule as to simple tools is accepted or rejected in the particular jurisdiction. If the employer knows that the tool is defective, or should know, having had the opportunity of inspection whether it is required by law or not, then he cannot advance the plea that there was a similar duty on the workman which was not exercised. The employer will not be allowed to profit by his own negligence or malfeasance.

In an Oregon case it was held specifically that an employer will be held to the exercise of ordinary care in furnishing his employees with either simple or complex tools, depending upon the nature thereof.

It is not consistent, as pointed out by Labatt, to hold the employer to a strict duty in the case of complex tools and to completely let down the bars in regard to simple tools. If a high degree of care is required in the case of complex and dangerous tools and appliances, then at least an ordinary degree of care would seem to be necessary in the case of simple tools. If a defective condition is so patent that it can be observed by even an inexperienced employee then it certainly must be as easily discernible to the employer as he hands it out to the workman.

If it is noticed by the employer and he hands it out to the inexperienced workman anyway, there should be no escape for him from liability in case the latter is injured unless he has pointed out the defect and explained it to the novice. If he has done this he may then be heard to offer the plea of assumption of risk on the part of the employee with some grace.

Little Chance to Escape Liability

Where the courts have not taken this view the legislative branch of the Government has, and the chance of an employer escaping liability for furnishing simple tools that are defective to his employees is very slight. In fact there has been a strong inference of negligence in cases where it was shown that the employer had purchased defective tools for his employees. And it would seem to be consistent with the law on the subject, especially in view of the safety-appliance acts, to say that this inference would obtain regardless of the specific expression of the law itself.

Specific legislation upon the subject in many states has rendered these fine distinctions obsolete and assesses liability against the employer regardless of the manner in which the injury was received, provided it was in the course of the workman's employment. But in those states having employers' liability acts of the old sort, and in those common-law states still existing, and in some of the safety-appliance statutes the rules announced above are still effective and in force.

It has been pointed out before that employers must not measure their liability for safe tools, appliances and a place to work with the fact that they are liable for the injuries a workman may suffer regardless of how the accident took place, The duty to furnish safe tools and appliances still exists and it should not be lost sight of in the maze of multitudinous legislation and decisions upon the former subject.

How the 155-Mm. Howitzer Is Made—I

By J. V. HUNTER
Western Editor *American Machinist*

One of the most important of modern field-artillery pieces is the 155-mm. howitzer. It is used to back up the 75-mm. gun both in counter-attacking and defence. This article takes up the work on the howitzer jacket after it has been rough-machined and heat-treated.

THE majority of shell, time-fuse and similar shops producing munition in enormous quantity have been laid out on the plan of regular progression of the work from one end to the other. This same idea has been applied in planning the gun shop of the American Brake Shoe and Foundry Co. at Erie, Penn. The number of howitzers ready for shipment to the proving ground and records of hundreds of others that have been proved and accepted bear testimony to the good work done at this plant. The gun shop is a concrete and steel structure 150 x 640 ft., with a main crane bay 60 ft. wide extending through the center and side bays 45 ft. wide on either side. The building is on a hillside and has a basement 300 ft. long under its south end. This lower floor has been mainly set aside for housing the welfare departments, with a portion in use for the heat-treating department.

The floor plan and layout of the machine tools is shown in Fig. 1. The gun forgings enter through the door at the north end and the finished guns, boxed for shipment, pass out to the loading platform from the corresponding south door.

The main idea of operation has been to produce what may be termed an evenly balanced shop. In other words the effort is made to have sufficient machines, jigs and fixtures for each essential part of the gun and breech mechanism so the required quantity may be manufactured each day to maintain the daily production rate of 10 completed howitzers. This rate has not yet been attained, but is rapidly being approached and would be possible now if the required delivery rate were being maintained on the jacket and tube forgings.

The shop operates with three equally balanced shifts of eight hours each, which rotate every four weeks. Only the special toolmakers work on a day shift; the heat-treating departments, restaurant, etc., operate during the 24 hours. The shop is as brilliantly lighted by night as by day and the management asserts that all shifts are equally effective. The main bay of the shop is served by four 5-ton cranes made by the Erie Steel Construction Co. This provides ample crane facilities for rapidly shifting the gun parts from one operation to the next, and relieves the necessity of providing any of the tools with individual jib cranes or hoists.

The general outline drawings of the howitzer and carriage are shown in Figs. 2 and 3. The majority of the parts as here shown, while not included in the making of the gun itself, give the reader a clearer idea of the details of mechanism required.

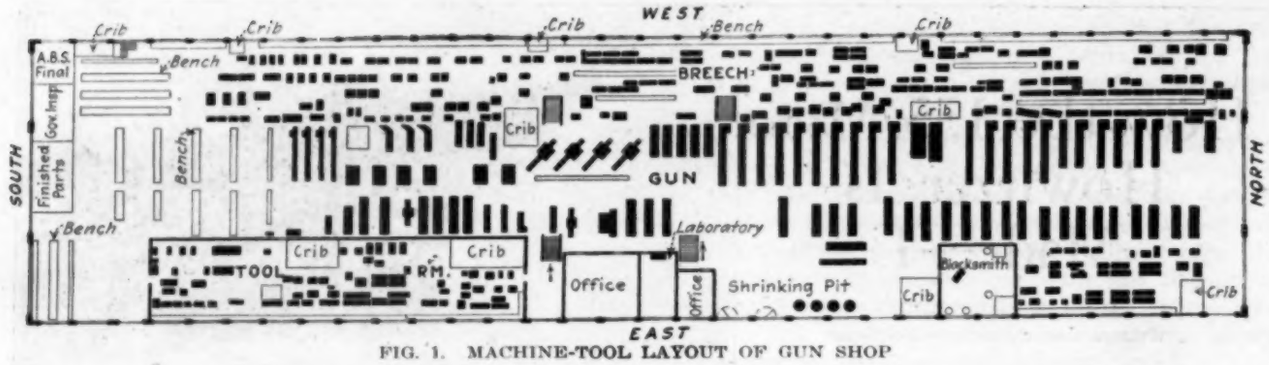


FIG. 1. MACHINE-TOOL LAYOUT OF GUN SHOP

Both tube and jacket are of alloy steel with a prescribed elastic limit of 65,000 lb. per square inch. The tube has a maximum working stress of 65,000 lb., and the jacket a maximum working stress of 57,983 lb. per square inch. These parts are heat-treated at the forging plant before forwarding to the gun shop, and after finishing they undergo no heat-treating process except that connected with shrinking the jacket on the tube. The drawings for the forgings for these parts as furnished are shown in Fig. 4.

The drawing of the jacket and tube after the finished machine operations, Fig. 5, gives a better idea of the general proportions of the howitzer. The layman will understand more from this of the manner in which the howitzer differs from the gun, since the former takes the place of the old-time mortar for firing at shorter distance, and possibly

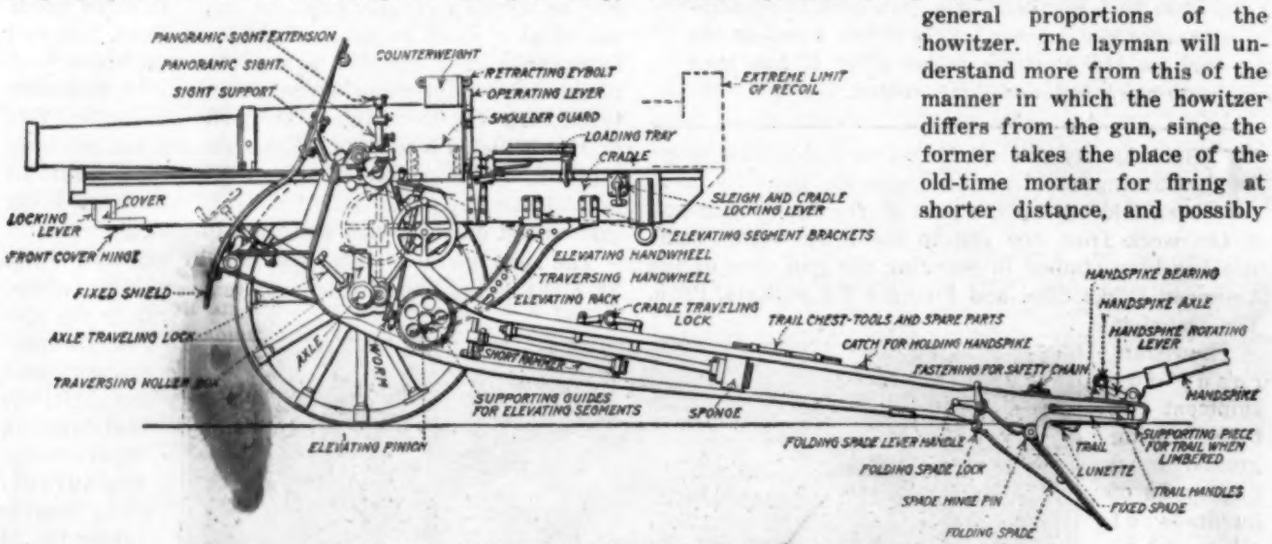


FIG. 2. SIDE ELEVATION OF HOWITZER AND CARRIAGE

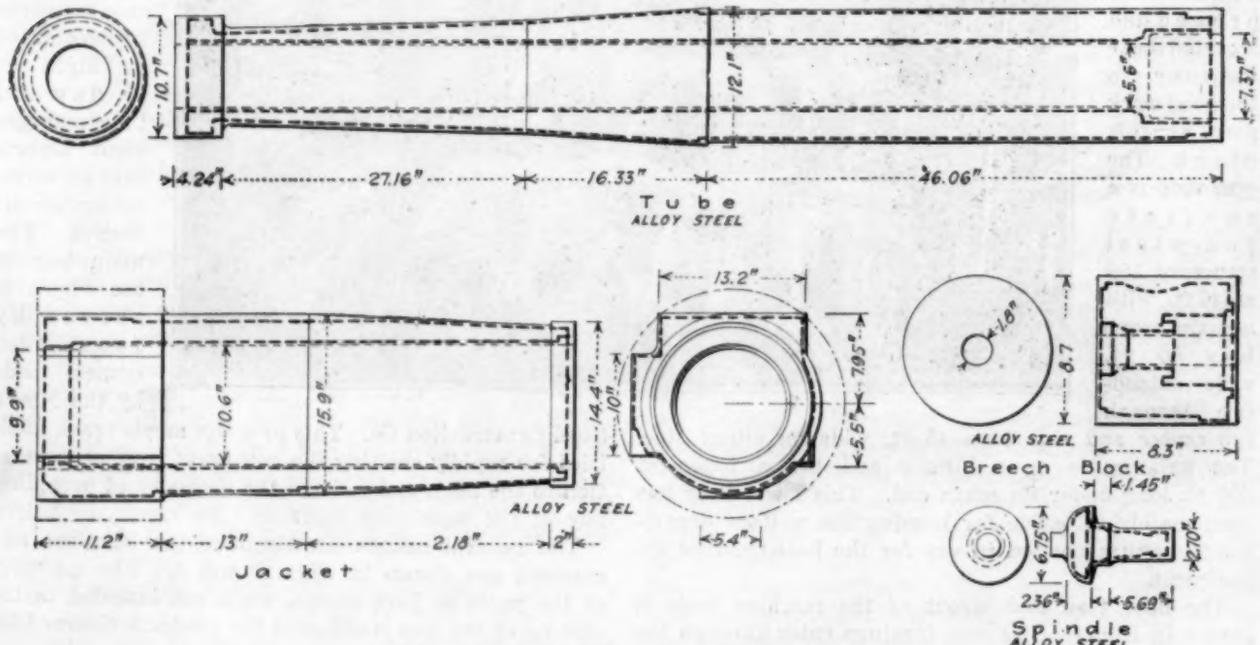


FIG. 4. ROUGH-FORGING FOR HOWITZER PARTS

has a lesser degree of precision because frequently used for indirect firing at relatively high angles.

The forgings for the howitzer jacket are furnished to the gun shop in rough-turned condition, as indicated in Fig. 6. In preparing for the first machining operations care must be taken in telltaling so as to determine whether the forging will finish to all the required dimensions and to properly adjust it in the lathe for turning the steadyrest spots.

The early plan was to use a chuck on each end of the jacket, having one chuck held on the tailstock spindle and to turn three spots for the steadyrests. This method was not satisfactory as the work instead of being round would be oval or egg-shaped, perhaps only a very small fraction of an inch, but still sufficient to cause future trouble. The method was therefore changed to holding the work in a cathead, as shown in Fig. 7, and after telltaling, boring to a depth of 3½ in. for a plug center. This procedure has proved very satisfactory.

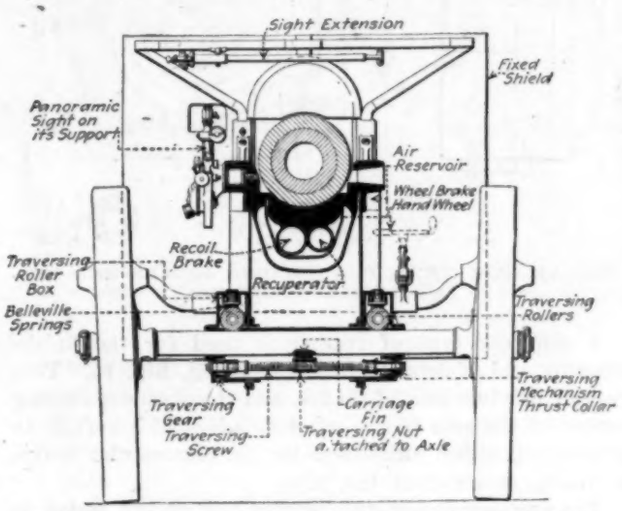


FIG. 3. FRONT VIEW OF HOWITZER AND CARRIAGE

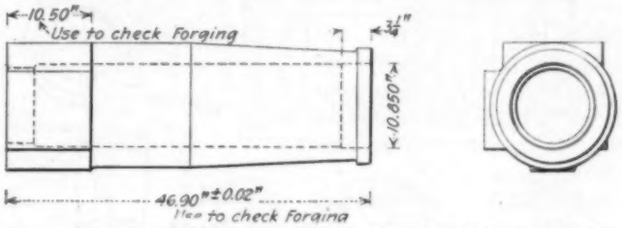


FIG. 8. TRANSFORMATION—FIRST OPERATION ON JACKET

The work of operation 1 in connection with facing the muzzle end and boring for a plug center is well illustrated in Fig. 7. The heavy type of dollie bar used for holding the boring tool is seen; also the cathead for supporting the muzzle end of the jacket.

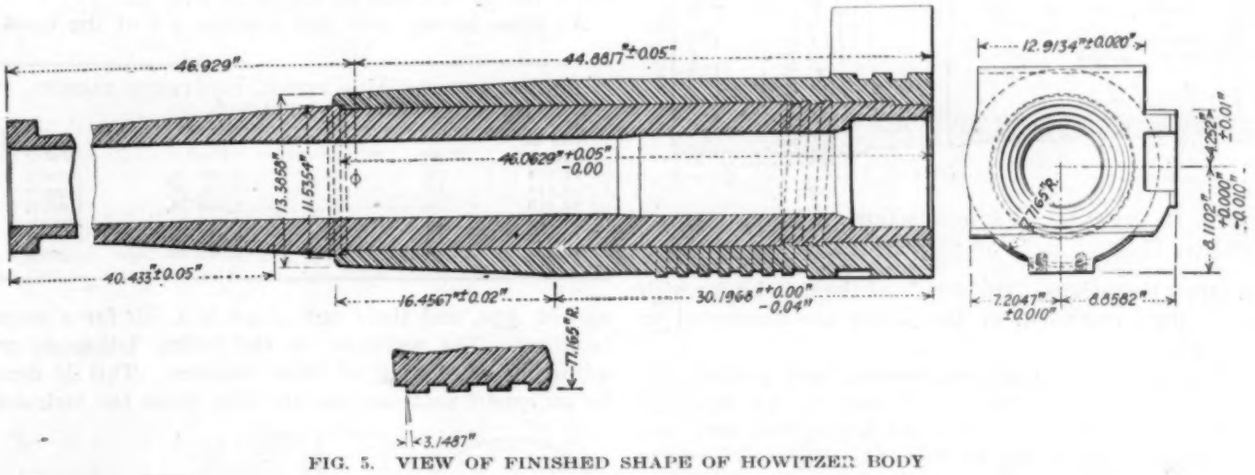
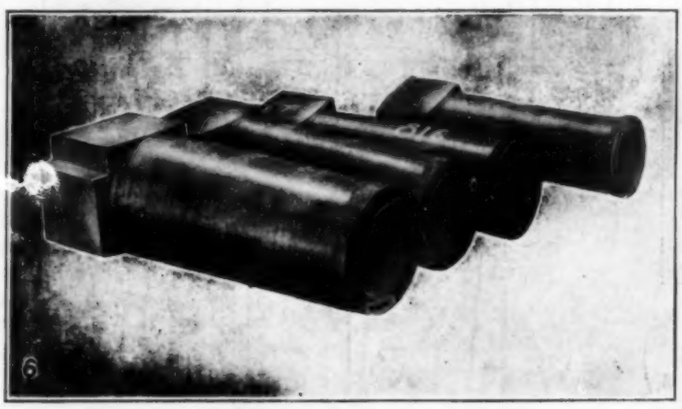


FIG. 5. VIEW OF FINISHED SHAPE OF HOWITZER BODY

The operation of rough-turning the jacket is illustrated in Fig. 11. For this operation the original plan called for the use of a profile-turning attachment, but this is no longer used. The straight portions are turned



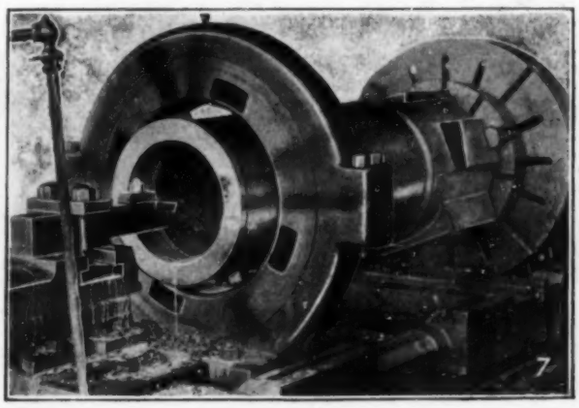


FIG. 6 AND 7. JACKET FORGINGS AND THE FIRST OPERATION ON THEM
Fig. 6—Rough jacket forgings as received at gun plant. Fig. 7—Turning three spots and boring for plug center

to a diameter and then the taper portions are blended into them.

The operation of rough-boring and finish-reaming the jacket is similar to the tube-boring and final gun-

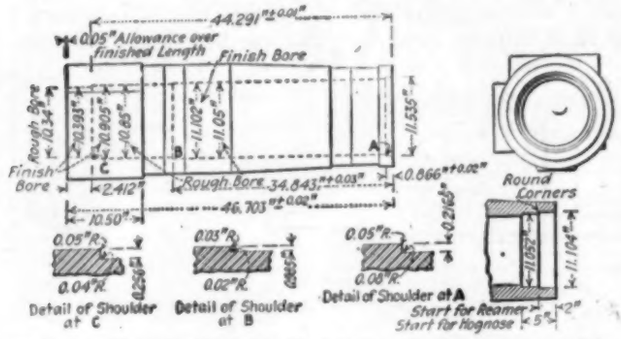


FIG. 9. TRANSFORMATION—FACE MUZZLE END, BORE AND FINISH-REAM

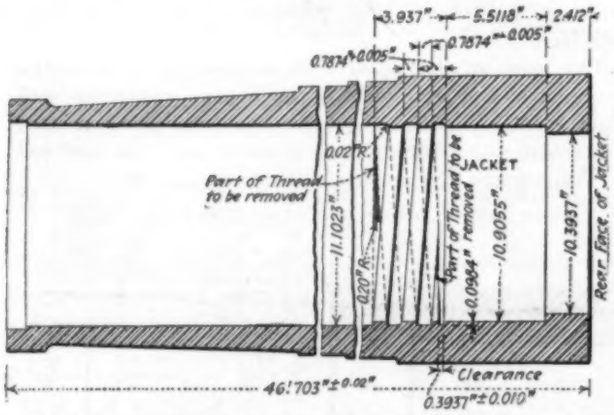


FIG. 10. TRANSFORMATION—MACHINE-THREAD AND FACE BREECH

reaming operations. The details of the pot chuck which holds the square end of the jacket are illustrated in Fig. 12.

Details of the boring and reaming tools used in connection with this work may be seen in the drawings here shown. Fig. 13 shows the boring-tool body and the cutters are shown in Fig. 14. The two grooves

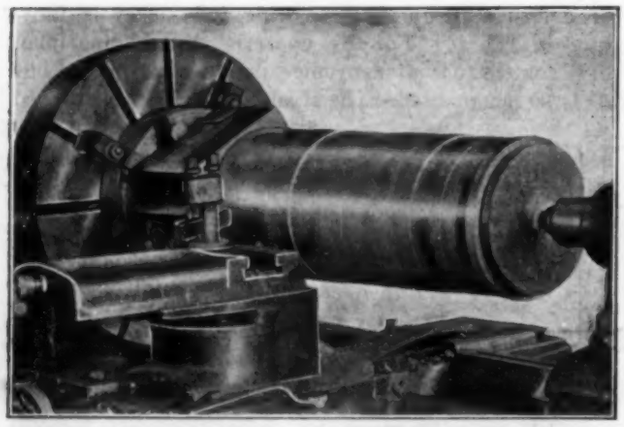


FIG. 11. ROUGH-TURNING THE JACKET AND TURNING THREE SPOTS FOR STEADYRESTS

cut through the sides of the body as shown at *A*, Fig. 13, carry brass oil pipes which convey the cutting oil under high pressure to the cutters.

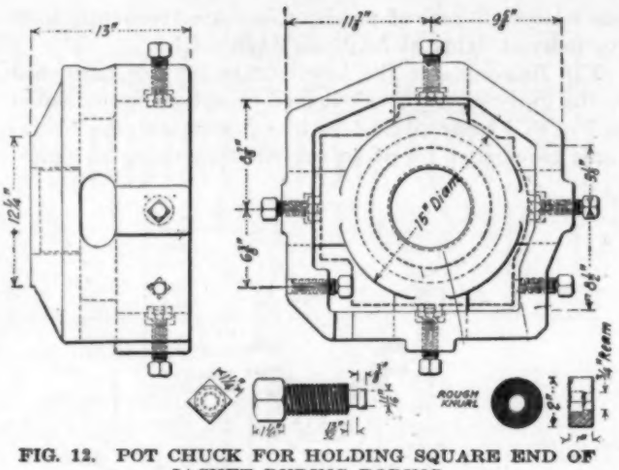


FIG. 12. POT CHUCK FOR HOLDING SQUARE END OF JACKET DURING BORING

A different type of reamer is used for the finish-reaming and is detailed in the drawing, Fig. 15. This reamer has two sets of blades, and the shoulder-cutting corner of the rear blades must be adjusted carefully to properly position this shoulder to receive the corresponding shoulder of the tube.

The counterbore at the muzzle end of the jacket is cared for by the reamer shown in Fig. 16.

All these boring tools and reamers are of the wood-

BORING SPEEDS AND FEEDS, HOWITZER JACKET, PART I, OPERATION 3

Size of Reamer	R.p.m.	Peripheral ft. per min.	Feed	Cut
11.050	10	29	0.060 in.	Rough
10.340	10	27	0.060 in.	Rough
10.850	10	28.5	0.060 in.	Rough
11.102	10	29	0.038 in.	Finish
10.905	10	29	0.038 in.	Finish
10.398	10	27	0.038 in.	Finish

packed type, and their care alone is a job for a large toolroom. The workmen on the boring lathes do no adjusting or stoning of these reamers. This is done by an expert sent out into the shop from the toolroom

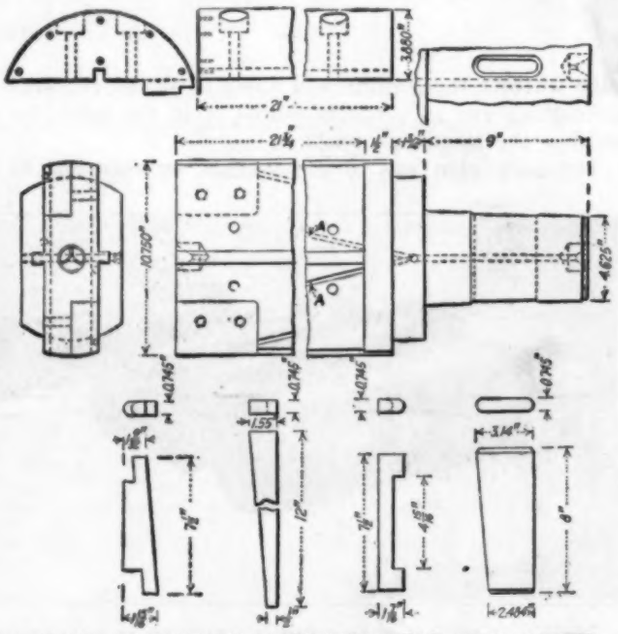


FIG. 13. BORING AND REAMING HEAD FOR JACKET

when necessary. After finishing each cut the reamer is sent to the toolroom for inspection, sharpening and repacking the wood fillers.

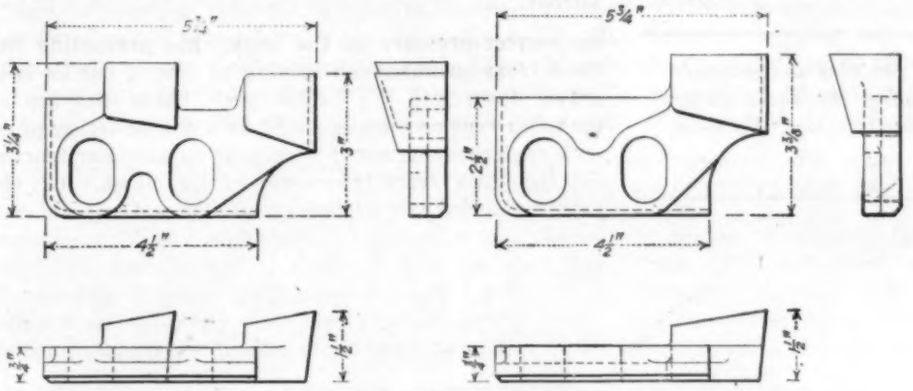


FIG. 14. CUTTER BLADE FOR BORING AND REAMING HEAD

The cutting speeds and feeds used for the reaming operations on the jacket are shown in the table.

For cutting the thread in the breech end for receipt of the tube the jacket is chucked from the muzzle end in a 27-in. by 16-ft. Reed-Prentice lathe, as illustrated in Fig. 17. The breech end is supported by a steadyrest. This work must be indicated with great nicety, and for this purpose the operator uses a dial indicator sensitive to 0.001 in. After setting up so that the total eccentricity of the bore does not swing out more than 0.003 in. the operator must call an inspector and obtain a release from him before proceeding with the work.

After obtaining the release he faces the end of the breech to a length. Then gaging from the shoulder in the bore he proceeds to cut the thread, using accurate profile thread gages. The manner of operation showing the very heavy tool bar may be seen in Fig. 17. From this point the jacket goes to inspection, where the bore is very carefully searched to locate any flaws that may exist owing to poor material or faults due to forging. Even the slightest flaws of this nature may subject the jacket to rejection. The bore is also stargaged with great accuracy for determining the diameters for each inch of length, these dimensions being used in connection with the preparation of the shrinkage drawings and for grinding the tube preparatory to shrinking on the jacket.

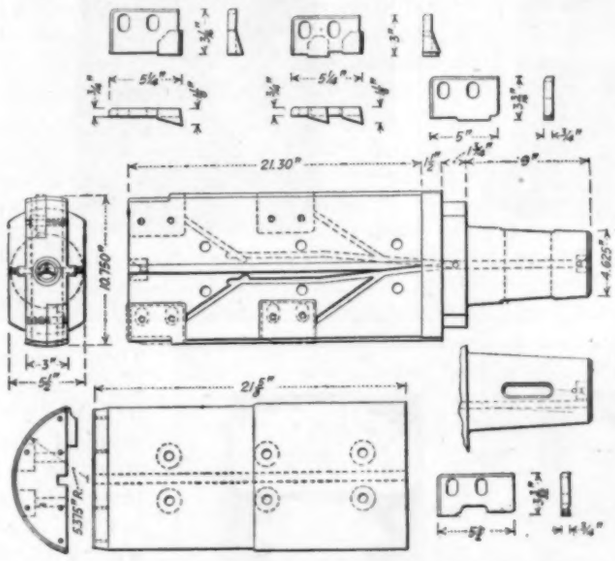


FIG. 15. DOUBLE REAMER BODY FOR FINISH-REAMING THE JACKET

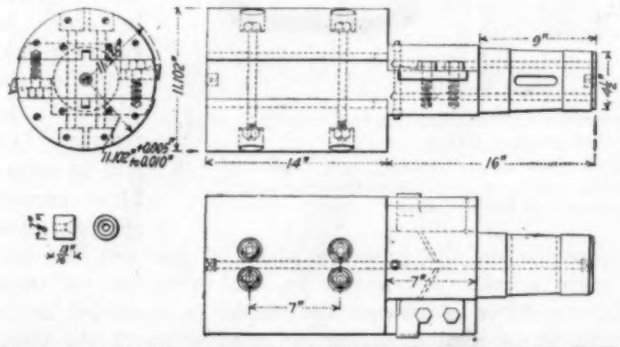


FIG. 16. REAMER FOR COUNTERBORE AT MUZZLE END OF JACKET

OPERATIONS ON THE JACKET

Operation 1.—Stamp serial and heat numbers at side of breech in ⅛-in. figures. Telltale and face muzzle end of a length and bore for plug center. Transformation—Fig. 8. Machines—Nos. 5001 and 5002. Type—30 in. by 16 ft. 6 in. Pond lathes. Tools—Cathead, telltale, plug center, breech-end chuck. Cutting speed—35 to 40 ft. per minute; feed, 1/64 to 1/16 in. per revolution, according to hardness.

Operation 2.—Rough-turn and turn three spots. Machines—Nos. 5005 and 5006. Type—36 in. by 16 ft. Le Blond lathes. Tools—Plug center, special breech-end chuck, snap and length gages. Cutting speed—35 to 40 ft. per minute; feed, 1/16 to 3/32 in. per revolution, according to hardness. Coolant—Soap solution.

Operation 3.—Face muzzle end to a length, bore and finish-ream all diameters. Transformation—Fig. 9. Machines—Nos. 5038, 5039, 5040, 5041, 5042. Type—38 in. by 12 ft. Le Blond lathes. Tools—Boring bars, boring tools and reamers, inside micrometer, snap gages. Coolant—Houghton's No. 2 cutting oil.

Operation 4.—Machine thread and face breech to a length. After chucking inside bore must be indicated with micrometer dial (allowable total variation 0.003 in.), and released by inspector before cutting thread or facing. Transformation—Fig. 10. Machines—Nos. 5044, 5051, 5053, 5054, 5055. Type—27 in. by 16 ft. Reed-Prentice lathes. Tools—Dial indicator (0.001), pin gages, thread tools. Indicate and release; note indication on release.

Operation 5.—Stamp serial number on muzzle ring opposite counterweight section. Remove fins and make shrinkage drawings.

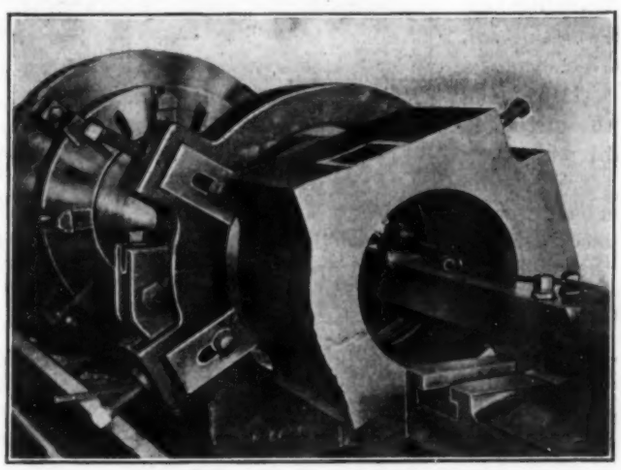


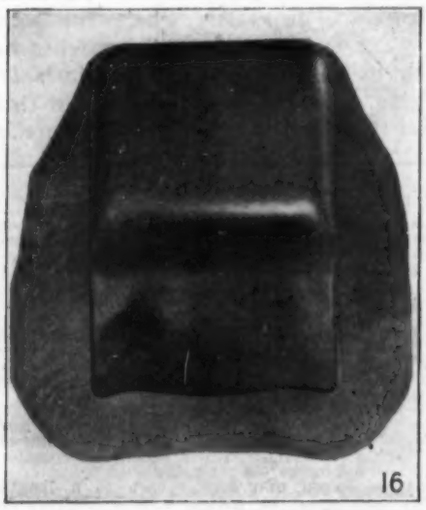
FIG. 17. CUTTING THE THREAD ON INSIDE OF JACKET

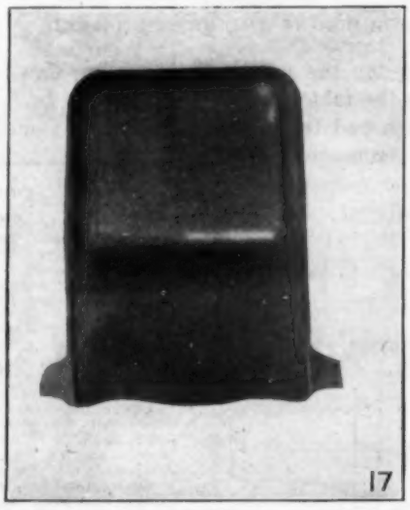
Manufacturing a Shorthand Machine—III

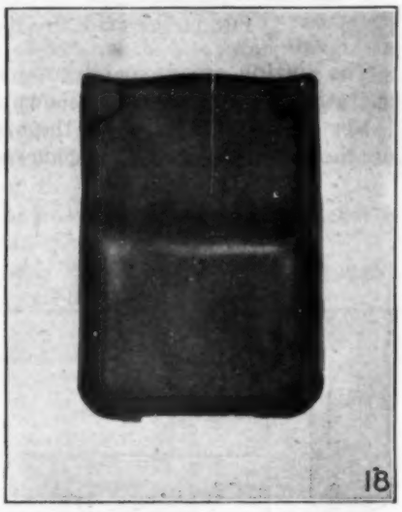
By M. E. HOAG

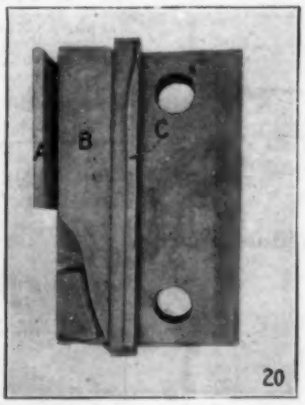
In this article are described the dies and methods used for drawing and forming the sheet metal that forms the case of the standard National shorthand machine.

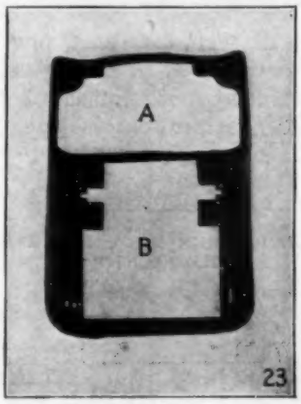
THE case for the National shorthand machine is drawn in one operation from sheet-steel stock 0.025 in. in thickness. This, in connection with the depth, contour and irregular form and depth of draw, makes a very difficult piece of work, and the methods and dies are therefore of unusual interest. The stock is first blanked out into an irregular oval shape with broad, flat ends. The blanking die is sectional, the various sections being so arranged that they form a rim about one inch in width all around the cutting edge; the body of the die is made of cast iron, as is quite generally the practice in work of this kind.











FIGS. 16, 17, 18, 19, 20 AND 23. PROGRESSIVE STEPS IN DRAWING THE SHEET-METAL CASE AND SOME OF THE TOOLS USED

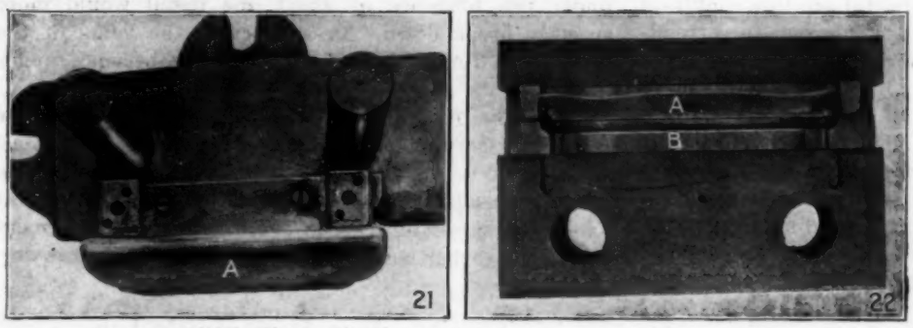
Fig. 16—The case as first drawn up. Fig. 17—Case after being trimmed. Fig. 18—Case with edges turned under. Fig. 19—Die for turning edges of case. Fig. 20—The punch used with die, Fig. 19. Fig. 23—A finished case

The drawing dies are made much the same as drop-forge dies would be for a similar piece of work. The female die is exactly the form of the finished case, as is also the male die, with the exception that allowance is made for thickness of metal in the case. A pressure plate is used on the male die to hold the blank flat during the drawing and is backed up with springs to give the correct pressure on the work, thus preventing the stock from buckling and serving to iron it out as it is drawn down into the female die. These dies are of the pillar type and are operated by a double-acting press with moderate ram speed to prevent punching or tearing out the stock from the center of the blank. On the extreme lower end of the press stroke the male and female dies compress the stock and form it to contour and iron out any wrinkles that may have developed in drawing. The result of this drawing operation is shown in Fig. 16, which shows the case just as it comes from the dies with the flash or fin of metal still attached.

There is nothing unusual in the mechanical construction of these dies, but no small amount of time and experimentation was required in order to get the proper radius on the edge of the female dies and to secure the correct spring compression on the pressure plate. These are the two main secrets of success in the operation of these dies. After drawing, the flash is trimmed in a simple die similar to the one used to punch the blank and leaves the case in the form shown in Fig. 17. The two ears are left on to form lugs which receive rubber bumpers, or feet, for the machine to rest on, and are trimmed, turned in and punched as required in separate dies.

The sides and ends of the case must now be turned

under as shown in Fig. 18. Two dies are used for the sides, a right and a left. One of the dies for this operation is shown in Fig. 19. The case is slipped over the anvil block *A* and held in position by the workman until the punch comes down, when the wedge *A*, Fig. 20, forces the case up tight against the anvil. The stripper *B* then comes into action and forces the case down solid against the anvil and prevents buckling while the punch



FIGS. 21 AND 22. PUNCH AND DIE FOR FORMING FRONT END OF CASE

C draws the edge of the case down to form. The front edge of the case is slightly more difficult to form and is handled with the die shown in Fig 21, which is similar in construction to the one for the sides, having an anvil block *A* over which the case is placed and caught by the stripper *A*, Fig. 22, while the work is being operated on by the punch *B*. The rear end of the case is handled in the same way as the two foregoing operations and leaves the work as shown in Fig. 20. There still remains the final punching operations to form the opening in the top. The opening at *A*, Fig. 23, is made with one operation, but the one at *B* is made by two dies, one of which cuts to the two projetcions near the center and the other punches out the remainder of the large openings and also the small holes and slots. The punches and dies for this work are not unusual in construction except that they are so shaped that they conform to the contour of the case and support it during the punching.

There are a very large number of dies in use in the National shops, but they are similar in principle and operation to those shown in articles already published in recent issues of the *American Machinist*. It is the practice of the National shops to use pillar or subpress dies for all of their work to avoid loss of time in setting up and also to insure longer life of the tools.

Aluminum die castings are used in the construction of the machine wherever posible and lend greatly to the lightness of the finished product as well as to reducing the machining operations necessary to produce a first-class finished product.

The Proper Annealing of Steel

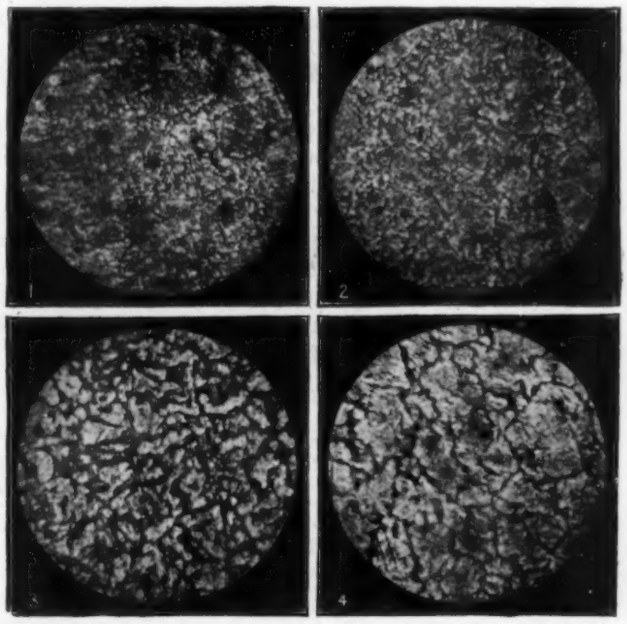
BY PAUL KREUZPOINTNER

With the universal application of the microscope to determine the structure of steel, and the establishment of heat treatment upon a scientific basis, the details of this application have become so involved and the terminology so complex that there is danger to the less scientifically trained mind of the everyday worker in steel of losing sight of the fundamental qualities which these processes are designed to attain.

Practical metallurgy, while susceptible to a considerable degree of reduction to precise mathematical expression through the medium of the testing machine, the microscope, the scleroscope and the pyrometer, still refuses to be squeezed wholly into the straitjacket of mathematical rule and formula; hence the personal equation must always be considered in metallurgical operations of whatever nature. My experience with the use of the microscope in connection with the heat treatment of steel, which began about 1885 when steel axles and steel castings first made their appearance on the market in large quantities, has confirmed my belief that consideration of this personal factor is indispensable to success in metallurgical operations in the mill or testing laboratory. For this reason a plain restatement of the function of annealing, which is the fundamental operation of all heat-treatment, may be of service to the average steel worker.

The primary object of the annealing process is to produce a uniform structure in the steel, to break up coarse crystallization and thus relieve internal strains. This coarseness represents a disturbed condition of the elements of which the structure is composed, and the annealing operation tends to stabilize these elements and bring them into a condition of equilibrium.

The unstable condition of the elements may be the



FIGS. 1 TO 4. EFFECT OF ANNEALING UPON CAST STEEL
Fig. 1—The original structure. Fig. 2—After proper annealing. Fig. 3—After "soaking" at proper annealing heat. Fig. 4—Showing effect of overheating

result of the casting, rolling or forging operations and the accompanying rapid changes in temperature which tend to retard the rearrangement and disposition of these elements according to their natural attraction or affinity; consequently we anneal the pieces to provide

opportunity for this rearrangement, but in this process we must bear in mind that each element has a different melting point; hence the heating must proceed slowly to give each element ample time to soften.

When all elements are in proper receptive condition they are ready to combine with each other according to their chemical affinity, the result being a uniform and therefore a stable chemical and physical composition in which all the particles of the metal are in a condition to offer equal resistance to any extraneous force tending to bend, break or distort the material.

Change in Carbon

Besides this rearrangement of the elements, which requires not only the proper degree of heat but also sufficient time to allow for the gradual transformation of the various chemical elements, annealing also serves to change the hardening carbon of the steel into temper or annealing carbon, which requires heat but apparently does not need time.

The degree of heat at which steel is to be annealed depends not only upon the grade of the material but upon whether the object of annealing is merely to make the metal more pliable, as in the case of boiler plate, or to produce uniform condition of structure as in steel castings. Whatever its object the underlying principle is always to produce maximum uniform working conditions of the steel. Even though a piece of steel is to be hardened—as for instance, a tool—it will be stronger if carefully annealed before hardening, the reason for this being that the hardening heat is not sufficient to equalize the irregularities in the structure.

At 1200 deg. F. the hardening carbon changes into temper or cement carbon, but the steel should not be allowed to "soak" at that heat, as this condition induces the formation of oxides. Neither should the heat be allowed to reach 1342 deg. F., as at this point the carbon undergoes another change.

The microphotographs here shown are illustrative of the effects of annealing. Fig. 1 is a section of a locomotive axle of good steel, but which had been badly treated in the mill. The irregularity of the structure is apparent, the dense portions indicating hard spots. The unsuitability of the steel for its intended purpose was proved by the results of the tensile test, the breaking load being 106,000 lb. per square inch with a 10-per-cent. elongation in 8 inches.

Testing Methods

In order to prove that ill treatment and not the quality of the steel was the cause of the irregularity a section of the axle was cut into quarters, one piece being left in the original condition while the other three were annealed at different degrees of heat.

In Fig. 2 the piece having been properly annealed the beneficial change is apparent, and is indicated by the tests which showed a breaking strength of 88,000 lb. per square inch and an elongation of 34 per cent.

In Fig. 3 we see the result of "soaking" the steel. The structure is open, each crystal being imbedded in a mass of softer material. While the strength is still satisfactory, being 84,000 lb. per square inch, the disproportionate decrease in elongation to 23 per cent. would indicate to the expert a loss of "staying power" in respect to its recovery after stress.

The piece shown in Fig. 4 has been overheated. The crystals have become excessively large and their cohesion impaired. While the steel of Fig. 3 could be refined by careful heating and cooling that in Fig. 4 is fit only for remelting.

The comparatively high results of the tests are due to the manner of testing, the stresses being applied slowly, giving the metal time to gather strength, whereas under the influence of shock the metal would more speedily break down. In such cases the value of the microscope for analyzing the structure becomes manifest.

From the foregoing it will be seen that to secure maximum service from machine parts of cast steel as well as to enable them to be machined efficiently careful annealing by slow uniform heating to the point where the hardening carbon is transformed into cement or temper carbon and equally slow cooling is necessary.

The Modern Foreman's Job

By John P. Commentz

How many of you fellows realize that the days of the old-fashioned foreman are over?—those "good old days" when the foreman knew from long association every man in his department, just what each could do and just how best to handle him; when he had the policies of the business "under his hat," and before the cost of labor turnover and individual workers' productive records were discovered. Those were good old days—except when things went wrong.

How many know what a foremanship means today, especially in war times? First of all the foreman is an executive, not merely a "strong-arm man." He is a natural leader of men, able not only to boss an operation but to instill the shop spirit into the men under him by the strength of his personality.

The foreman is the last man in the world who can afford to play favorites in dealing with his men. He is charged by the management with the actual production that should come from every machine every working hour. He is charged with the cost of his labor turnover, that is, the cost of hiring and training men for his department, and is held responsible for all the details, reports, etc., required by the complex manufacturing conditions of today.

A foreman cannot afford to keep a hopelessly inefficient worker an hour, neither can he afford to let go without a thorough trial a worker who has the makings of a producer. The best man in the shop, if he be a disorganizer, a trouble maker, is a handicap to his foreman as well as to all the other men, and is sure of a short shrift. The foreman must, for his own sake, give every man under him a fair deal.

Under these conditions a foreman must sink or swim with his men. Increase the hourly product of the machines and both foreman and men will be sure of material benefits; decrease production and you all know what happens. War time and excuses do not mix.

The foreman is captain of his team and responsible to the management for results. He has a *real* job; he has troubles of his own and plenty of them, but remember he is working with you, not working you. Back up your captain and everybody wins out.

Generating a Square Hole with a Gear-Shaper Cutter

BY DOUGLAS T. HAMILTON
Fellows Gear Shaper Co.

The quantity production of pieces containing holes of other than round section, the sizes and shapes of which must be accurately maintained, has always been a bugbear to the production engineer. The following described method of producing square holes seems to offer a simple solution of otherwise difficult problems.

THE generating principle as applied to gear teeth has received considerable attention, but its application to the production of irregular forms is not so well understood. On first consideration the square hole, as a generating proposition, appears to be impossible, but upon further reflection we find that a flat surface can be generated, and obviously a square hole, being merely a combination of flat surfaces, lends itself admirably to the process.

The application of the Fellows gear shaper to this purpose is well exemplified in a detail of construction of the horizontal milling machine built by the Cleveland Milling Machine Co. In this machine the work-arbor support, which is shown at *A* in Fig. 1, is held on a square bar which is set obliquely in the head of the machine, the latter being made in two parts to facilitate the machining operations in fitting it to the square-sectioned bar.

With this form of support there is no side movement of the arm, and when the hole for the cutter arbor is

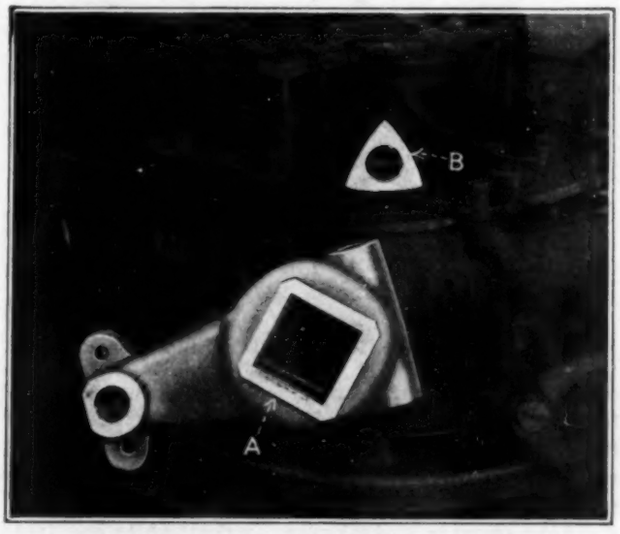


FIG. 1. THE WORK AND THE CUTTER

bored with the arm in place on the machine upon which it is to be used it evidently must hold the cutter arbor in perfect alignment with the work spindle.

One problem in connection with the production of this supporting arm, which appears at first sight to be difficult of accomplishment, is greatly simplified by the use of a cutter of the generating type as shown at *B*. This cutter is three-cornered with curved sides, the latter being relieved to make them free cutting.

Before describing the fixture and the application of this cutter to the generating of a square hole it may be advisable to explain briefly the principle.

Reference to the diagram, Fig. 2, will show clearly how the work is accomplished. Once we have obtained two rolling circles, one for the cutter and one for the

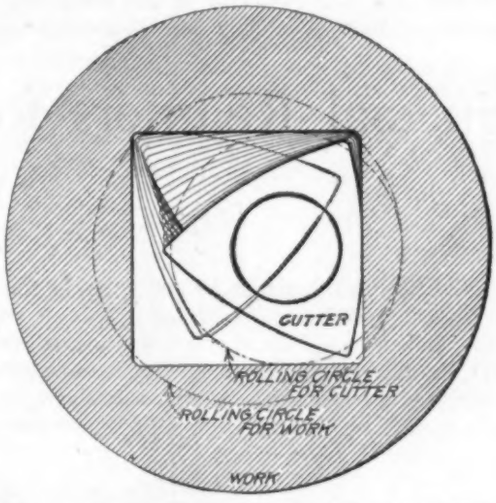


FIG. 2. HOW A THREE-CORNERED GEAR-SHAPER CUTTER GENERATES A SQUARE HOLE

work, we can determine accurately the form of cutter necessary and also the relation between the rotation of the work and cutter spindles. The cutter, of course, must be smaller than the hole, consequently to cover the surface represented by the square hole it must make a greater number of turns than the work. The relation in this case is 4 to 3, as the work has four sides and the cutter only three.

By graphical means it is now possible to show how this three-cornered cutter generates a square hole. It has been represented in Fig. 2 by means of a series of light lines showing the relative positions of the cutter and work (the work being represented as stationary in order to eliminate the large number of lines that would be necessary to show both cutter and work), these lines representing the generating path of the cutter.

For handling the work an interesting fixture was developed. The work spindle was fitted with a faceplate and also with a special arbor which holds two types of locating blocks, one a round one which is used first to locate the work from the cored hole, and the other a square block accurately fitted to the finished hole. The rough casting is first located in position on the round block and one end of the square hole as far as the recess in the center is generated to the exact size. This operation is performed on a batch of castings, after which the round locating block is removed and the square one is substituted. The work is then re-

versed on the fixture and the other end of the square hole generated.

As to the advantages of this method of producing a square hole the following may serve to explain some of the important points. In the first place any desired fit can be secured by feeding the gear-shaping cutter further in or holding it back; thus it is possible to secure a fit that cannot be obtained by other commercial means. In fact it has been found in actual use that it is possible to secure absolute interchangeability of these square holes without perceptible backlash and to obtain a fit approximating that of a finely finished plug gage.

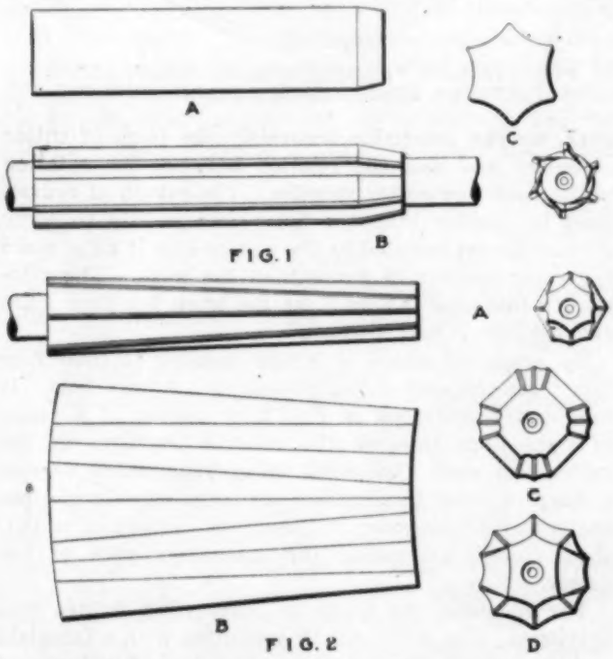
Those who have had experience in producing close-fitting parts interchangeably know that unless there is the possibility of adjustment in the machining tool, duplication of parts can only be obtained when the machining tool is up to its proper size; as soon as it wears down variations will result. With this method, however, it is simply a matter of feeding the cutter in further to compensate for resharpening.

There are limitations, however, to the application of this principle. The maximum length of stroke of the Fellows gear shaper is 5 in., and this limits the length of the hole that can be machined. It is obvious that a stiff cutter is the only one that can be absolutely depended upon to machine a part accurately from end to end, and therefore it must be large enough to resist deflection when of a considerable length, which precludes the commercial application of the principle to the machining of very small holes. In the other direction the size is limited by the size of the cutter, as it is obvious that the cutter must be large enough so that one side will complete one side of the square hole.

Special Reamers for Correcting Chattered Surfaces

By F. W. Bach

I EXPERIENCED trouble at one time in finishing the cartridge chamber in 12-gage shotgun barrels. This chamber was of the shape shown in outline at *A*, Fig. 1. The finishing followed the machine-chambering operation, which reamed the chambers to within 0.006 in. in diameter and 0.05 in. in depth of the finish sizes.



FIGS. 1 AND 2. SPECIAL FINISHING REAMERS

The 0.006 in. in diameter was taken out by two hand reamers, with the work held in a vise. These reamers were made with different forms of tooth, one of which is shown at *B*, and was a duplicate of the last-used machine reamer except for size, being 0.0045 in. larger in diameter, leaving 0.0015 in. to be taken out by the finishing reamer, which was a scraping reamer, or broach, similar to the familiar Stubb's five-edged broaching reamers, the only difference being that the spaces were milled between the teeth with a convex-faced cutter instead of a flat one, which left flutes deep enough to carry more chips. This section is shown at *C*.

The trouble started with the machine reamers, which would get out of order and leave a rough or wavy surface. This chatter would remain in the chamber surface after all the other reamers were used, for the reason that all the reamers had the same number of flutes as the machine reamer which caused the trouble.

The usual method of preventing or correcting this

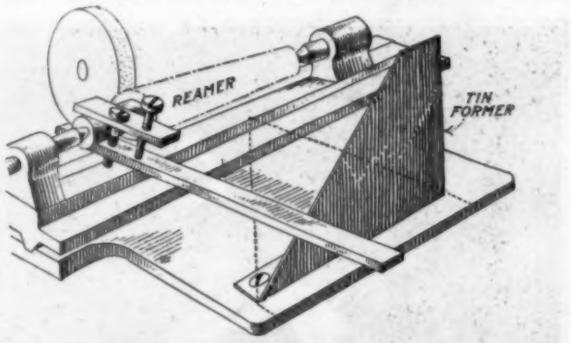
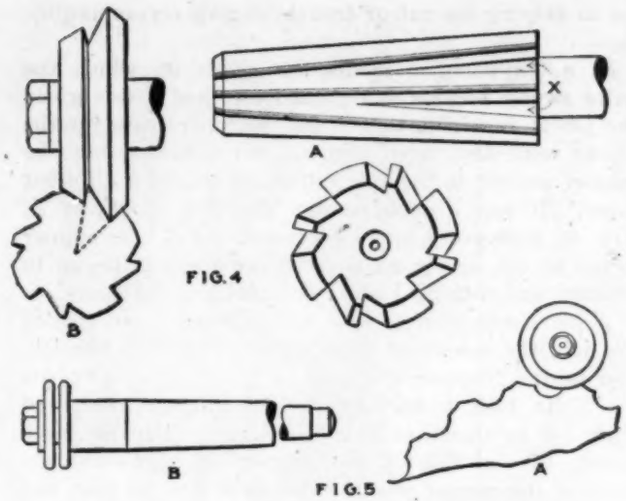


FIG. 3. DEVICE FOR GRINDING SPECIAL REAMER

condition when using several reamers in succession is to give each following reamer a different number of flutes which should be prime to the number in the reamer preceding. For instance, starting with a reamer of eight flutes we should then use five, four, seven and six flute reamers successively, so that while one tooth may be in a chatter groove the others are all cutting on a "high spot," and in that way correct any existing error from this cause.

The reamers with an odd number of flutes require special fixtures or gages to measure their sizes and more tools and more operations would be necessary for their manufacture, thereby increasing the cost.

As we had made thousands of these chambers with



FIGS. 4 AND 5. OTHER FORMS OF REAMERS

very little trouble it was not deemed advisable to change the tools or operations, though we occasionally got a few bad chambers when a new reamer was started. This time, however, we got so many before the reamer got righted that I decided to make a reamer that could be depended on to correct them and to keep it for others that might follow.

I conceived the idea of combining straight flutes with right- and left-hand helical flutes in one tool to take care of any kind of waves. The tool shown at *A*, Fig. 2, is a reamer with four straight flutes and two right- and two left-hand helical flutes. The surface development of this tool is shown at *B*.

To make the reamer I made a blank of tool steel and hardened and ground it to 0.002 in. in diameter larger than finish size, the 0.002 in. being left for honing.

This blank was then placed on index centers in the grinding machine, and with a small-diameter wheel eight flutes were ground lengthwise, making four "teeth" as shown at *C*. Next, by the aid of a clamp, or dog, with a long tail used in connection with a sheet-metal former fastened to the bed of the machine, as in Fig. 3, two opposite teeth were ground, starting

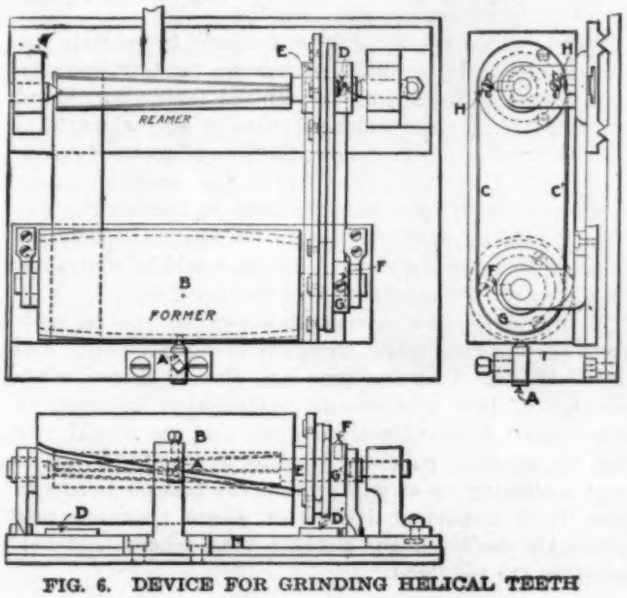


FIG. 6. DEVICE FOR GRINDING HELICAL TEETH

one-twelfth of a turn to the right of the straight teeth, making two right-hand helical teeth. Then the former was changed end for end and two left-hand helices ground in the same manner. After grinding out the V-shaped patches of surface left and honing all the teeth to a sharp edge I had a reamer, the shape of which is shown at *D*, Fig. 2, which worked very satisfactorily. This reamer was made several years ago and is still ready for business.

In making another I should mill it before hardening and have it as shown at *A*, Fig. 4, milling it with a double cutter as shown at *B*.

Later it was found that a reamer with teeth as at *B*, Fig. 1, and having the same tooth characteristics as Fig. 4, could be more easily made and ground to use in place of our first-finish reamer to correct the chatter, following it with our regular finish tool. It was made as follows:

The blank was turned to about 0.030 in. larger than finish on the taper to take care of the spring in hardening. It was then placed between centers on the milling machine, the dividing head being set for

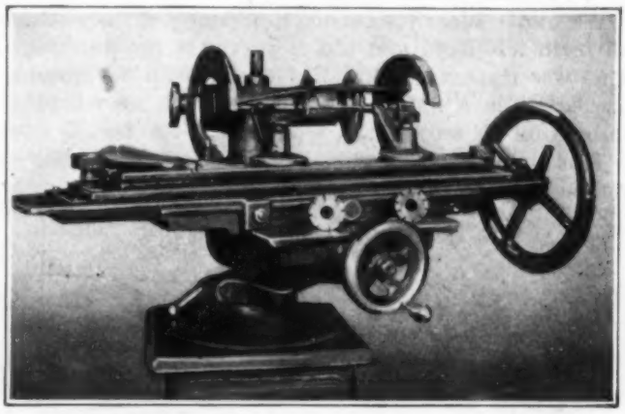


FIG. 7. ANOTHER DEVICE FOR GRINDING REAMERS

12 teeth, and with a spiral fluting cutter, used on all teeth to get a smooth tooth face, the blank was notched for 12 teeth. Four equally spaced straight teeth were then milled, two cuts being made for each tooth as shown at *A*.

The right-hand helix would make one-twelfth of a turn in 4½ in. or one turn in 54 in. Two right-hand and two left-hand helical teeth were then cut and the V-shaped patches *X* taken below size, making a reamer that can readily be ground and backed off on any reamer-grinding machine.

Later a parallel hole 1 in. long and 0.695 in. in diameter in the muzzle end of shotgun barrels gave the same trouble, so a reamer was made at at *A*, Fig. 5, but with a helix of one turn in 36 in. This was a scraping reamer, and to make it I used two convex-faced cutters $\frac{3}{4}$ in. thick, 1½ in. in diameter with a spacing collar between them, as shown at *B*. A fixture necessary to grind the helical teeth was made as in Fig. 6. The stationary finger *A* in a post fastened to the bed of the grinding machine engages in the helix cut in outside of the master former *B* as the carriage of the grinder is moved back and forth, and through the watch-spring belt *C*, *C'* partly rotates the reamer which is held between the machine centers.

As each tooth is ground the reamer is changed so as to bring another tooth to the emery wheel by loosening the headless setscrew *D* in the hub of the driver, which is a turning fit in the connecting plate *E*. The former is adjusted for helix wanted by screw *F* in the hub *G*. The bed is connected and held in position by straps.

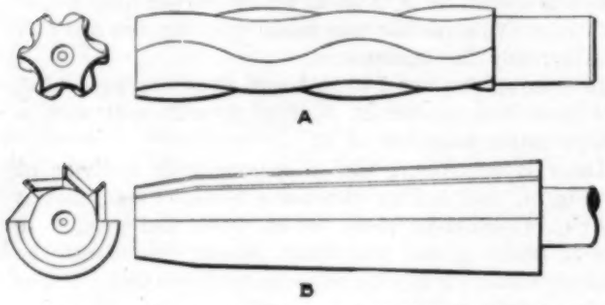


FIG. 8. OTHER FORMS OF SPECIAL REAMERS

The two parts of the watch-spring belt are tightened by adjusting the two parts of the driver by means of the screws *H*. The straight teeth were backed off on the regular grinding machine.

We also made an eight-tooth scraping reamer with all teeth left hand and use it regularly for finishing. This was made with a lead of one turn in 36 in. and backed off in a fixture I had made some time before to back off six-tooth finish reamers.

This fixture is shown in Fig. 7. The two radially slotted disks on the front of the machine are eight- and

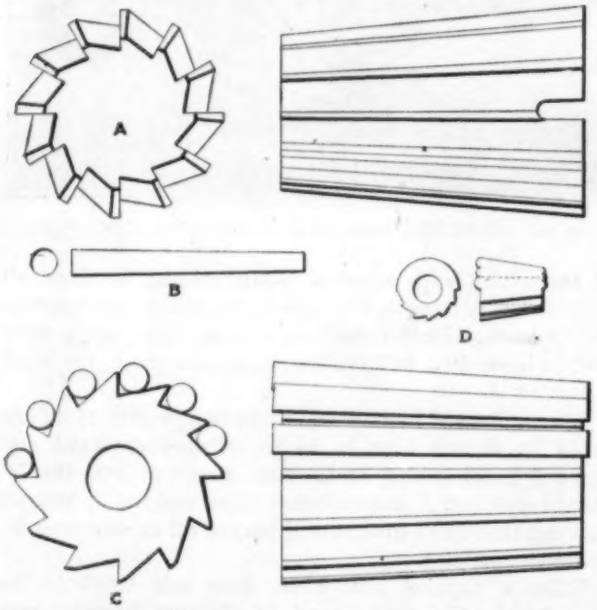


FIG. 9. TAKING THE CHATTER OUT OF TAPER REAMERS

ten-tooth index plates for the toolholder; the one in use on the machine has six slots.

At one time we had some small rifle barrels, 0.217 in., which for some special reason were to be reamed to 0.220 in., which we did with two reamers, with teeth as at *A*, Fig. 8, each cutting 0.0015 and doing a good job.

The above is all original. Later I found some old reamers like *B*, which had been made by some toolmaker for a similar purpose, the principle being the same as the kink a journeyman machinist once showed me in helping me out of trouble during my apprentice days.

In a trip-hammer saddle the pivots on which the helve swung became worn and loose, and I was given the job of repairing them. As the taper seats for the pivots were also worn they needed reaming, but the reamer nearest to the size and shape was of a different taper. It was a shell reamer like that shown at *A*, Fig. 9, and everything went well until the reamer began to cut nearly all the way around. It began to chatter, and nothing I could do made any difference.

While I was looking at it and fearing I had spoiled the job, the machinist came along, looked at the job, and said: "I guess I'll have to see if I can't fix you up." He took a half dozen lead bullets, hammered them out as shown at *B* and packed them in six tooth spaces of one side of the reamer, as at *C*. Slowly turning the reamer into the chattered hole he soon had it as smooth as glass. The reamer when through had the appearance shown at *D*.

Wasteful Transfer of Help

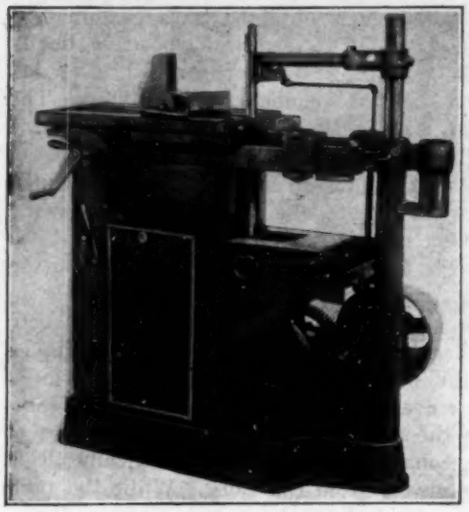
By Luther D. Burlingame

We read of the vast number of persons employed on Government work in the shipyards, munition factories, etc., and picture these places as beehives of industry where enormous quantities of war material are being produced at top speed. We think with pride of the ability of our Government and people to rise to the occasion and carry on such industries on a vast scale. But the pride of some who have had access to many of these Government or semigovernment enterprises has often received a shock when they have witnessed the misdirected effort of the workers who are permitted to idle away their time because of nothing to do or, if having something, of not doing it.

A prominent manufacturer of machinery stated that a visit to one of these establishments gave him the impression that practically half of the men were either doing nothing or inefficiently doing something. He also remarked that he believed that if half the force were discharged the work would progress even more expeditiously and that much more man power would be released for other work and for army service.

As our shops are being "fine combed" to get help for the needed governmental enterprises and it becomes necessary for those shops to replace their experienced employees with inexperienced ones it seems wasteful to have these ablebodied men, the loss of most of whom has crippled the industries (even the essential ones) from which they have been removed, so inefficiently employed. Consequently any steps by which the labor of these men can be made more efficient would be equivalent to adding to the man power of the country.

In organizing new enterprises allowance must be made for a certain time to get things working smoothly. But it would seem that the time has already passed when excuses of this kind should be tolerated in many of these great Government concerns, and we should now ask the question pointedly whether there should not be such a shaking up as will prevent the further taking of men from important industries where they are now efficiently employed and putting them where only half services are rendered.



A New Slotting Machine of the Milling Type

By J. V. HUNTER
Western Editor *American Machinist*

Of late years the machine-tool industry has been rather fixed in its character, and while from time to time improvements are made in the standard types, it is only at infrequent intervals that new types are produced or a familiar type adapted to a new line of work.

THE machine tool which we have the opportunity of describing is different from the prevailing types and its possibilities embrace a wide field. This machine, which has been brought out by the Racine Tool and Machine Co., Racine, Wis., is as yet without a suitable name to describe it, but is known as the No. 25 design. It is built in only one size, but the maker intends to make other sizes in the near future so that a complete line will be available. This machine was first exhibited at the exposition of the American Foundrymen's Association at Milwaukee in October of this year, and a view of it is shown in the headpiece. It can be simply described as an interior milling machine which operates a milling cutter having somewhat the character of a broach. It is essentially a milling machine in the manner and character of its cut, but these milling operations are primarily intended to be performed on interior openings and for such surfaces as have heretofore only been possible to reach with slotting, broaching or keyseating machines. In its ability to execute these operations it fills a demand of thousands of machinists and shopmen who have always desired to mill interior surfaces and corners in order to obtain a fine and accurate surface, and is a distinct gain to the machine-tool and machinery building industry of today. The cutting member of this machine is practically identical with the teeth on the periphery of a standard milling cutter should these be laid out in a straight line. In their action they cut a chip similar to the chip produced by the milling cutter, and the rate of cut and appearance of the cut is essentially the same. However, there is this difference in the appearance of the cut, that because each tooth cuts the full length of the stroke on the cutting surface it leaves no feed mark of the teeth on the actual surface where it is cutting and the surface will have a smooth, almost polished, appearance. Reference to the illustration of this machine in Fig. 1 will show that its essential parts consist of a base casting *A*, which holds many of the main parts in their proper relationship, and likewise acts as a reservoir for the coolant fluid. The body casting *B* provides support for table, and has ways on its side for guidance of the vertical sliding-tool bracket. In the interior of the body is placed the mechanism for the table feed. A top casting *C* is placed over the body and has ways on its top face to provide guidance for the forward and backward motion of the table. This top piece has also been extended with the arms *D* which furnish support and guidance for the vertical sliding frame. These arms are furnished with bronze-lining sleeves to provide for the wear of the vertically reciprocating arms. The cutting member of the machine is

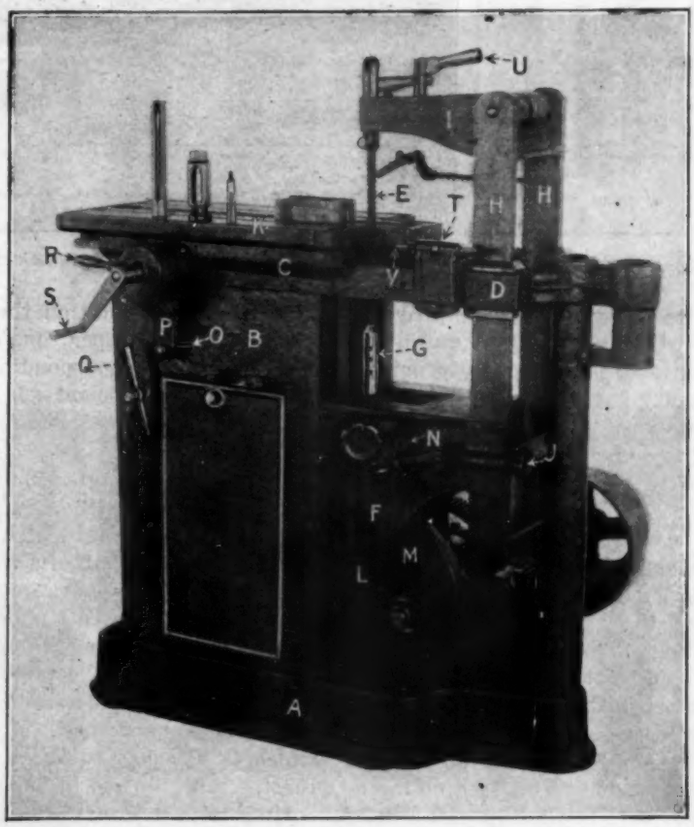


FIG. 1. THE MILLING TYPE OF SLOTTING MACHINE

Specifications.—Floor space, 26 in. by 48 in.; height over all, 54 in.; weight, 1250 lb.; table size, 14 in. by 28 in.; strokes per minute, 20 to 60; diameter of cone pulleys, 8, 10, 12 in.; belt width, 3 in.; pulley speed, 30, 60, 90 r.p.m.

the straight-line milling or cutting bar *E*, which is carried at its lower end by the bracket *F* which slides on and is guided by the ways on the side of the body. An adjustable steel gib on the inside of the bracket takes up any wear on the gib and ways. The actual attachment of the cutter bar to the bracket *F* is by screwing it into a socket *G* which is fast to the bracket. This socket is also adjustable for different lengths of cutter bars.

The pair of frame arms *H* which are carried in the vertical motion by the bracket *F* have at their head the overhanging arm *I* which serves for additional support at the upper end of the cutter bar. The guide arms may be raised and lowered to accommodate different lengths of tools by loosening the hand nuts *J* which clamp them to the bracket.

The table *K* is similar to that of a milling machine, but has a slot 2 in. in width extending lengthwise through its center for about one-half of its length,

The feed of the table is obtained by a combination feed and release clutch. The feed is not positive, but is governed by the pull of a spring-controlled lever arrangement situated on the inside of the main body. The operation of the crank-disk cam serves to release the pressure of this spring, which is connected to the stud *O* extending from the interior of the body to the end of the feed-clutch lever *P*. The pressure of this spring and the consequent rate of feed of the table is regulated by the hand lever *Q*, which stretches the feed spring to any desired tension.

The cam-like periphery of the crank disk is in contact with a roller on the end of a double-lever arm located within the body. When the irregular form of the cam pushes over on the lever this action releases the tension on the spring during the return stroke of the cutter bar, consequently the table practically clears the face of the cutter from the work. While the table

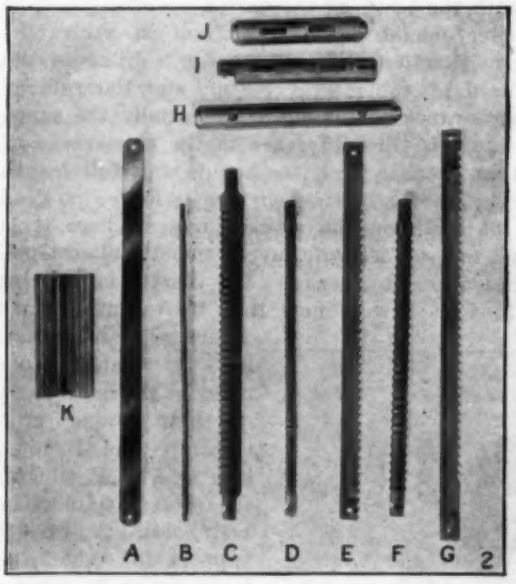


FIG. 2. VARIOUS BARS AND SOCKETS

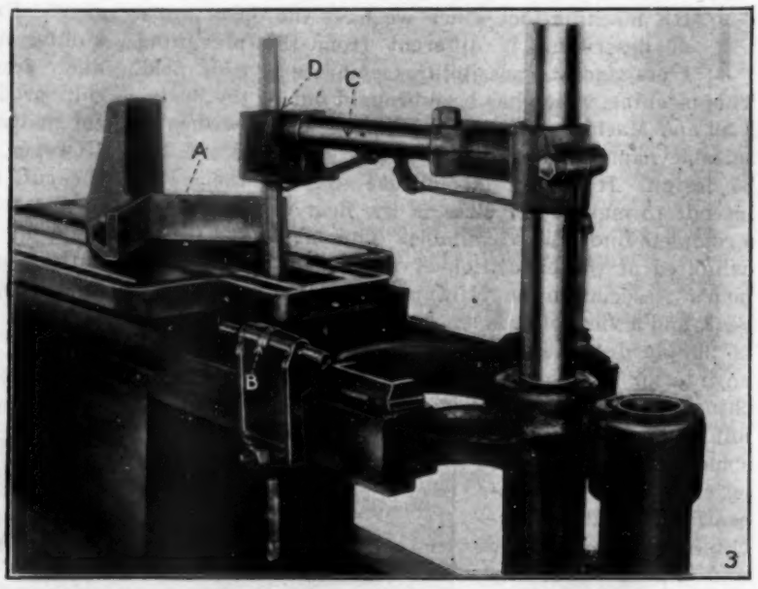


FIG. 3. MACHINE WITH KEYSEATING ARM IN PLACE

thus permitting the table to be fed forward toward the cutter for that distance without coming into contact with the cutter bar. This table is adequately provided with T-slots for the necessary fixture and work-holding bolts.

The reciprocating motion for the cutter bar and its supporting parts is imparted by the crank disk *L* operating the connecting-rod *M*. This connecting-rod may be adjusted for length of stroke by changing its radius from the center of the crank disk; for this purpose the connecting-rod pin is held in a slot which permits adjustment. The length of the stroke may be varied within the limits of from 4 to 7 in. The upper end of the connecting-rod is pivoted to the bracket by the pin *N*; this bearing is bronze bushed.

The outer periphery of the crank disk has been arranged in the form of a cam for actuating the feed and release mechanism of the table. This feeding mechanism is such that it only permits feeding pressure of the work to exist on the cutter bar during the cutting stroke. On the return stroke all pressure is relieved and the work is automatically backed off a sufficient distance to free the teeth of the cutter

is in a release condition the feed clutch takes a new bite, and at the proper time again moves the table forward a distance corresponding to the amount it has retreated plus a sufficient additional distance to put the necessary spring-feed pressure on the cutter bar.

The clutch which provides the feed motion for the table operates through a shaft carrying a pinion, which in turn engages with a rack bar on the base of the table. When the feed-clutch handle *R* is down it holds the feed-pinion shaft in a positive position so that the table can only advance with the power feed. By pulling up this clutch handle the clutch is released and the pinion shaft may be rotated by the handle *S* to advance or relieve the table by hand as desired.

A supplementary device to this feed mechanism is provided by a handwheel on the rear of the machine, which is attached to the extension of a threaded rod that permits the rod to be screwed up against the feed-spring release lever. So doing holds the table in a fixed or locked position from which it may be moved neither forward nor back, and in this condition holds the table while setting up the work to alignment.

A micrometer-adjustment stop for the table is pro-

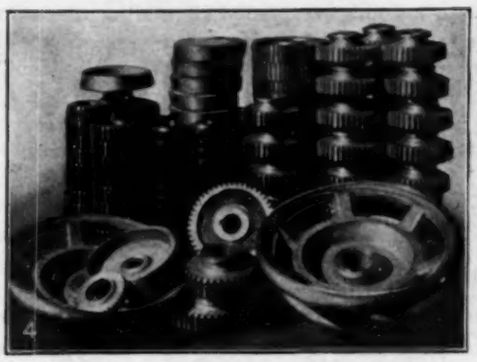


FIG. 4. VARIETIES OF KEYSEATING OPERATIONS

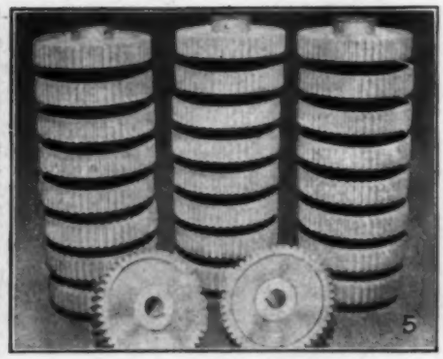


FIG. 5. KEYSEATING OF ALUMINUM GEARS

FIG. 6. SLOTS CUT IN TOOLPOSTS

vided on the bracket *T*. By means of this the table may be automatically fed forward to any predetermined distance, but when it reaches this stop further forward feed is arrested.

A coolant is used on these cutter bars as on any milling cutter, a pump directly geared to the shaft being provided at the rear of the base and drawing its supply from the reservoir located in the base. The machine as now built is provided with a step-cone pulley. Later designs have a three-speed gear-box drive of the tumbling gear type. The machine is also furnished with direct motor drive.

Some of the different types of cutter bars used on this machine are shown at *A* to *G* inclusive, Fig. 2. It will be noticed that the teeth on these cutting bars are of the same height and character throughout their length. In this they differ from broaching cutters but become more similar to milling cutters, as previously noted. These cutter bars can be made in an unlimited variety of sizes and types; and the range here shown is from a hacksaw blade to any style of round or angular form. Some are arranged to screw into the lower socket, as previously indicated; others fit over a pin-hook socket of the kind used on hacksaw-frames. Some of the sockets are shown as *H*, *I* and *J*, Fig. 2.

The upper end of each cutter bar is held by a quick-action clamping fixture shown at *U*, Fig 1. By this means the bar may be tightened or instantly released to swing the overhead arm back for the removal of the work.

Underneath the table, at about the point indicated by *V*, is located a removable bracket shown at *K*, Fig. 2. In use this bears against the smooth surface on the back of the cutter bar and takes up all the thrust pressure of the work. Round cutter bars have a smooth surface milled on their back face for a bearing against this thrust support.

The overhead arm and slides for the support of the upper end of the cutter bar are not required or desirable for all kinds of work. For some occasions a different supporting arm, as shown in the illustration, Fig 3, is used. This is an adjustable swinging arm with a flat face at the point *D* where it is in contact with the back of the cutter bar. This arrangement is more satisfactory for such work as the keyseating of gears or pulleys as shown in the work illustrated in Fig. 4.

For this work a V-block *A*, Fig. 3, is clamped to the table in the proper position to hold the work in the necessary relation to the cutter bar. The feed stop *B* is then set to give a uniform depth of keyway on all pieces of the work. The removal of finished pieces and replacement with fresh parts is rapidly accomplished by simply swinging the arm *C* to one side and lifting the work directly over the top of the cutter bar.

This machine is remarkable because of its ability to do a variety of work which in the past needed several machine tools to accomplish. In addition to the keyseating operations shown in Fig. 4 a similar operation was performed on the aluminum gears shown in Fig. 5.

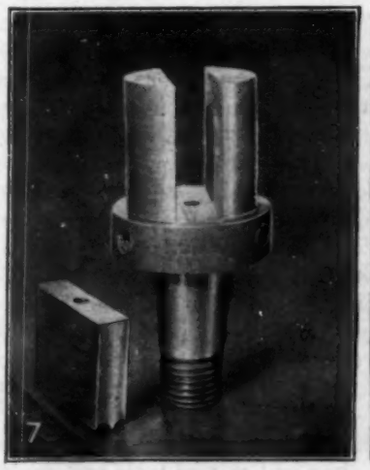


FIG. 7. SLOT CUT THROUGH HEAVY PART

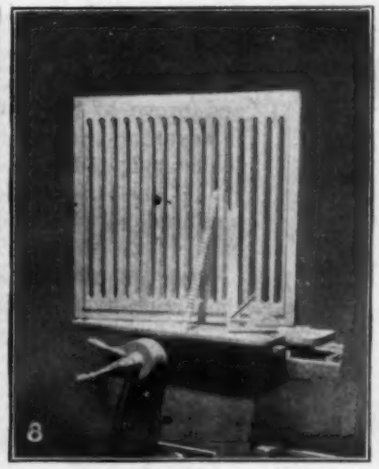


FIG. 8. CARBORUNDUM STICK MOLDS AND SLOTTING BARS

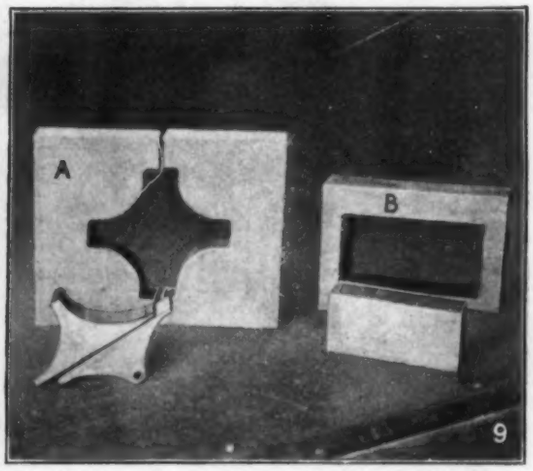


FIG. 9. MACHINED INSIDE OF OPENINGS IN DIE BLOCKS

Toolposts such as are shown in Fig. 6 are also slotted out. Each of these slots was started from a drilled hole and they are $\frac{11}{16}$ in. by 2 in. through machine steel of $1\frac{3}{8}$ in. in diameter, requiring a cutting time of 10 min. for each.

Other work performed was the cutting of the slot in the part shown in Fig. 7. The piece removed in this case stands at the left and the marks of the drill holes that were drilled at the base for starting may be detected at the bottom of the piece removed, although the cutter has squared up the corners of the base of this slot into a nicely machined condition. This slot is $1\frac{1}{2}$ in. by 4 in. through steel of 80-point carbon, with a cutting time of $1\frac{1}{2}$ hours.

A serviceable use of the machine is demonstrated in the production of the mold block shown in Fig. 8. These cast-iron molds are used for forming carborundum blocks used in munition work, and are furnished with the slots cored $\frac{5}{8}$ in. in width in the casting, leaving a hard, rough surface for machining. The finished slots require 45 min. apiece to finish them to $\frac{3}{4}$ in. by 16 inches.

One of the great possibilities of the machine appears to lie in the production of punching dies. Starting the work from a single $\frac{11}{16}$-in. hole drilled through one corner of a desired opening, the die block shown at *A*, Fig. 9, was quickly milled to form. This block was afterward split into the two halves shown by placing a standard hacksaw blade in the cutter holders of the same machine. A simpler die block which has had its interior opening milled out is shown at *B*.

Keep the Home Shafts Turning

One day not long ago ye editor blew into a small manufacturing plant up state and found the manager, the master mechanic and the general foreman carrying on an animated conversation, the subject of which was

a small line shaft that was acting in an erratic and not too reassuring manner.

The plant, like many similar ones, was on war work, running a minimum of 24 hours a day, and the shaft in question had become overloaded by adding more and more presses, increasing their speed and imposing heavier work upon them until it threatened to double up in the middle and rip down its hangers.

One especially heavy press had just been started on a run of blanks, the delivery of several thousand of which had been promised for the next morning, and as the driving pulley for this press was located midway between two hangers the springing of the shaft had become so serious that the press was immediately stopped and preparations got under way to put up a new hanger. To do this it would be necessary to stop the line for several hours, which would entail the stoppage of several presses that were doing equally important work. To leave the big press idle meant a broken promise; to run it meant a broken shaft. Hence the conversation.

The tools could not be used in any other press, and the manager had about decided to explain to the customer that owing to the draft, and the prevailing epidemic and the unfortunate occultation of the moon and consequent shortage of water power with which to run the steam engine, the promised blanks could not be delivered until the end of the following week.

Just then the editor, who is not supposed to know anything about power transmission and such technical things, wanted to know why a stick "notched on one end to fit over the shaft, and cut just long enough to butt up against that post over there," wouldn't help.

It did. The stick was put in place in 10 minutes; the shaft was not stopped, and the manager delivered the promised blanks in the morning.

There is no moral to this yarn unless it be that it is not such a bad thing to have an editor on your calling list.

Giving Time or Cost of Tools

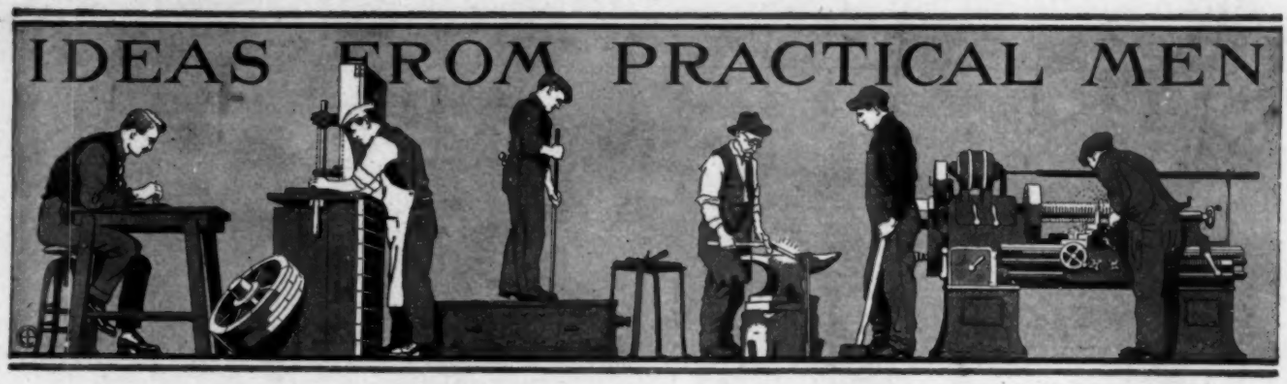
BY M. H. CHASE

I have often thought that the description of tools, jigs, dies and other tools may be enhanced by giving information on the actual cost of the machine being described. Often a description or drawing looks as if the tool were considerably more complicated and expensive than it actually is.

We still come across the shop executive who has a horror of jigs and fixtures and throws up his hands when new methods or tools are suggested for small lots. I have had several such experiences, and when I would show the boss a description or cut of a tool and prove to him where we could use a similar one to advantage, he would say it costs too much or it was too complicated. When I would tell him about what it should cost, he would say that my estimate was too low, and he would figure two or three times higher. Now if the description of the tool included the cost or hours required to complete it I believe it would make the article treated more interesting and valuable.

The cost or time mentioned with a tool should give an opportunity for a comparison of the cost of the tool described with the cost of a tool of the same kind in the reader's own shop.

[Mr. Chase is right, and we shall be glad to have contributors give the time and cost of tools and devices described wherever possible.—Editor.]

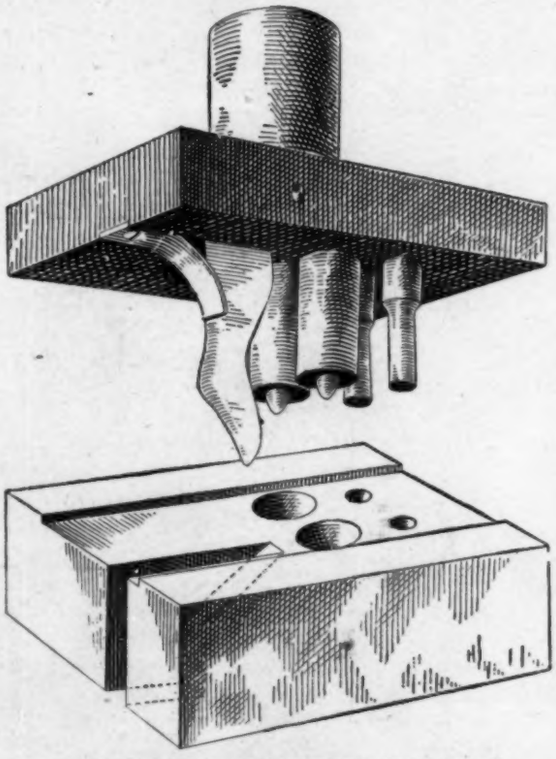


A Simple Automatic Feeding Device for Punch-Press Tools

By G. R. Smith

The drawings with this article illustrate how any single-action punch press may be used as an automatic on certain kinds of work simply by the style of tools used, with no attachments whatever on the press itself.

The tools shown are for the purpose of piercing and blanking washers, and while these lend themselves most readily to this style of tool construction there are many small blanks, rings, cups, etc., that may easily be made on the automatic dies, and there is no reason why blanking and forming operations may not be done in the same manner. The tools are very simple, may be made as sturdy and massive as the work requires, contain no delicate features, and are practical in every detail.



FEEDING DEVICE FOR PUNCH-PRESS TOOL

The cut shows a simple washer die with the stripper plate removed, blanking and piercing two, four, six or eight washers as may be required. A slot is milled in the front end in line with one of the large holes, and the punch has a feeding finger which works in the slot milled in the die.

Back of this feeding finger is a spring which pushes it forward against a stop when the ram of the press is raised. A small slot is milled in the punch pad into which the top of this feed finger fits loosely, being held in position by a pin.

With the tools set up in the press the operator starts the end of the strip or coil of stock by piercing the first small holes, then moves the stock forward until these small holes line with the pilots in the washer punch when the next cut is taken. Upon the next forward motion the feed finger catches in the first large hole and no more attention is needed until the strip is cut up, the press being run continuously and the feeding finger advancing the stock at each stroke of the press. The angle of the slot in the die and the shape of the finger are of course dependent on the work to be done.

Two Types of Interlocking Milling Cutters

By Donald A. Baker

On several occasions lately we have been asked to design interlocking milling cutters of the general type shown at *A*, Fig. 1, the persons asking for this cutter having assumed without taking the trouble to analyze this form of cutter that it was a good one and more simple to make than the one shown at *B*, which latter assumption is true, as it is not necessary to mill teeth on the inside faces to permit the cutters to interlock.

There are a number of other features, however, that more than offset this apparent advantage. For instance we find that on high-speed-steel cutters of say 6 in. in diameter there is a great waste of stock, as shown at *A* and *B*, Fig. 2, which illustrates two methods of getting out the blanks, the dotted lines showing where stock would have to be removed. By either method we are confronted with awkward machining operations, and the waste of stock is apparent.

But let us assume that the cutter *A*, Fig. 1, could be produced at less cost than the other. There is another feature that is more than likely to be entirely overlooked, and that is the matter of the adjustment of the cutter for width and its effect upon the life and efficient action of the cutter. The actual method of adjustment of the two cutters will be the same, namely, that of inserting shims of either thin sheet metal or

of paper between the cutters. This means that one type of cutter is as easy of adjustment as the other, so that neither has the advantage over the other in this respect.

Let us then analyze the effect of this adjustment in relation to the cutting action.

Adjustment of cutter *B* does not affect the interlocking of the teeth to any extent; every alternate tooth overlaps the next up to the point of maximum adjustment. On the other hand, let us look at *A*, which shows the other type of cutter opened to its maximum limit. Here we find that only one tooth on each cutter is equal to half the width of the cut. With the cutter adjusted as shown, it would leave a rough-stepped ridge from one end of the work to the other, which would zigzag back and forth as different parts of the cutter came in contact with the work. This goes to show that a cutter of this type loses its efficiency in proportion to the amount it is packed apart.

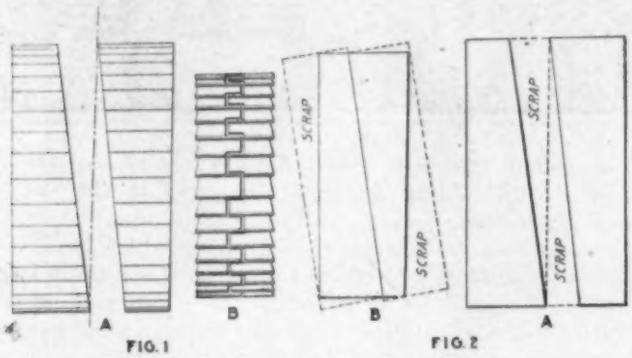


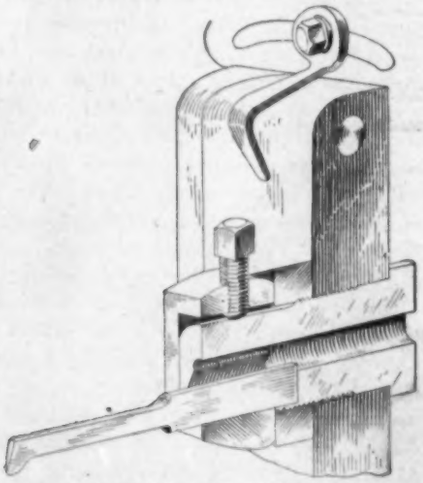
FIG. 1 AND 2. TWO TYPES OF CUTTER

Toolholder for the Shaping Machine

BY J. N. ETHERIDGE

The cut shows a shaping-machine toolholder that I designed and used for several years, finding it very handy for shaping out dies and strippers of irregular outline.

It is similar to one that was illustrated by Harry Lauterbach on page 85 of the *American Machinist* and has many features in common with the Bruno slotting attachment shown on page 596, Vol. 48.



ADJUSTABLE SHAPING TOOL

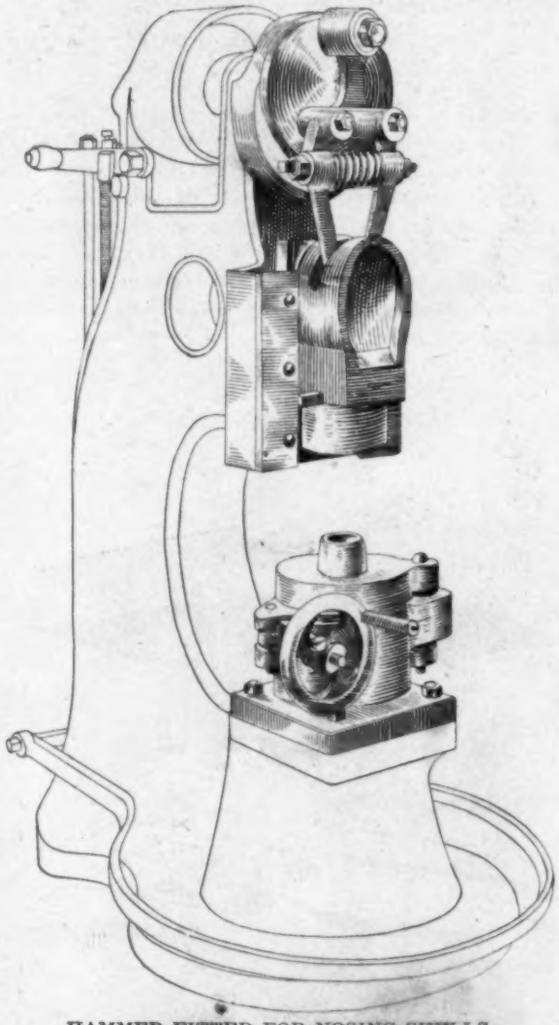
This toolholder takes in a wide range of sizes and shapes, holding round, square and hexagon shanks. The tool is held at three points by means of the setscrew as illustrated.

The spring shown at the top holds the tool down and keeps it from riding over the work; it is held in place by one of the screws that hold the clapper box.

A Shell-Nosing Hammer

BY E. A. THANTON

The use of a small power hammer to nose, or "bottle," the ends of shells is rather unusual. The illustration shows a hammer made by the Airedale Works of Schofield & Mitchell, Keighley, England. This hammer is fitted to nose the British 19-lb. shrapnel shells. The nosing die is carried in the hammer slide and the shell is held in the special fixture shown. By a slight turn of the handwheel the hinged part of the clamp may be released and swung back far enough to remove the shell. Another shell is as easily clamped in place after being heated. The machine runs about 250 r.p.m. and only two or three strokes are needed to nose in a shell. The top of the holding fixture acts as a stop for the nosing die which is hammered down until it butts on the top of the fixture.



HAMMER FITTED FOR NOSING SHELLS

SHOP EQUIPMENT NEWS

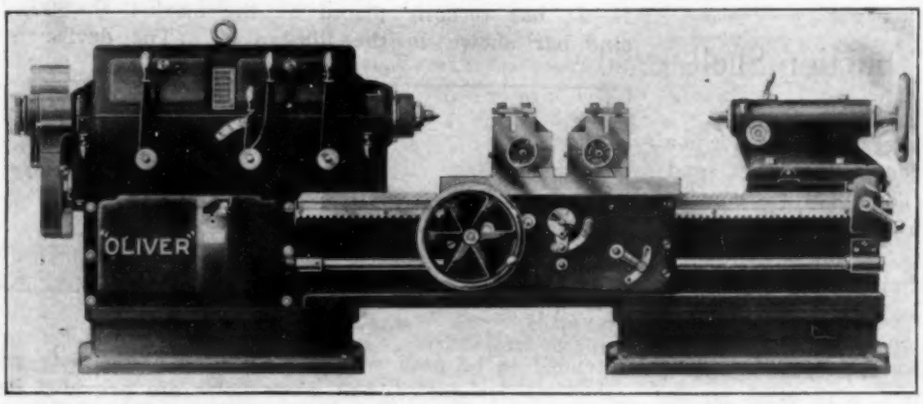
Edited by
Stanley M. Banfield

In conformity with a Post Office ruling, descriptions of new equipment can only be used in this department which have not been previously or simultaneously advertised in this or any other periodical.

Oliver All-Geared, 28-In. Lathe for Shell Work

The illustration shows the regular 28-in. engine lathe manufactured by the Oliver Machinery Co., Grand Rapids, Mich., equipped with devices to make it of particular use in the production of shells. It is a heavy-duty machine with an all-geared head, and may be arranged for single-pulley drive from either a motor or a line shaft. Heavy feeds are provided in order that heavy cuts may be carried and accurate work produced without danger of overloading the machine and causing breakdowns.

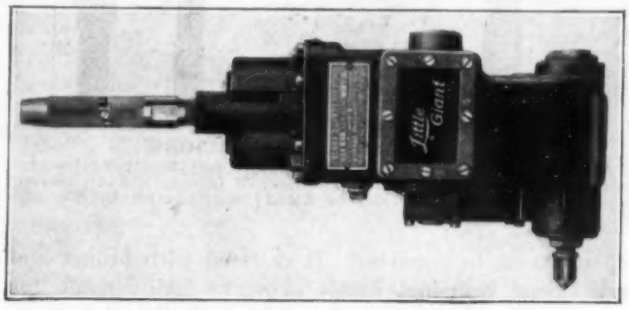
All gears are of steel and all pinions are of steel forgings. The spindle is forged from high-carbon steel and ground to size. The adjustable and replaceable bearings are of bronze. A double-wall type of apron is used with removable front plate, permitting easy access to the entire internal mechanism without removing the apron from the lathe.



OLIVER 28-IN. LATHE ESPECIALLY ADAPTED FOR SHELL WORK

"Little Giant" Compressed-Air Corner Drill

The compressed-air drill shown in the illustration is the product of the Chicago Pneumatic Tool Co., Fisher Building, Chicago, Ill. It is known under the trade name of "Little Giant," and is designed for use in

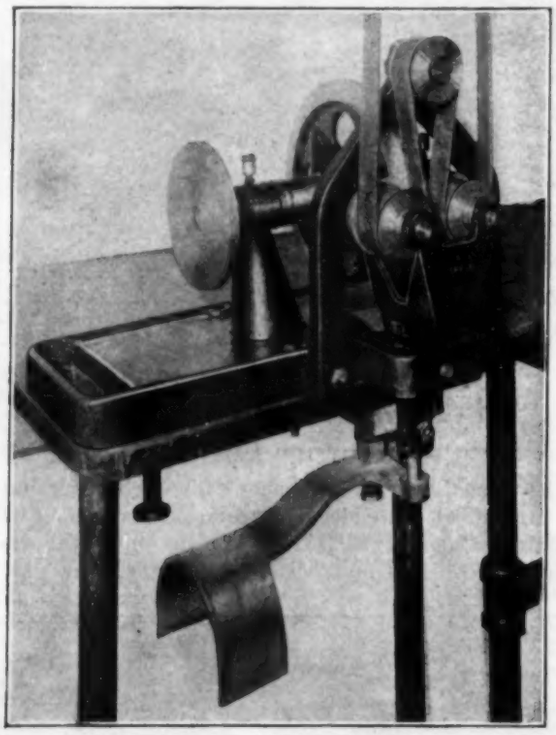


COMPRESSED-AIR CORNER DRILL

corners or close quarters. In this device intermittent action of ratchet levers has been eliminated, and a steady, uninterrupted revolution of the drill spindle is accomplished by a train of gears, thus retaining all the advantages of the ratchet type and permitting the drill to be used in the same narrow space, that is, within $1\frac{7}{16}$ in. of the end wall or corner. The drive from the motor to the spindle is through stub-tooth gears, special alloy steel being used in order to give increased strength. A feed screw is provided, located in line with the drill spindle, and is made with the customary cone point and squared head. The handle is equipped with the regulation control valve.

Beach No. 1 Lapping Machine for Cylindrical Shaped Work

The Beach Manufacturing Co., 80 Boylston St., Boston, Mass., is now manufacturing the No. 1 lapping machine shown in the illustration, which has been designed for lapping plug and ring gages or other similar work



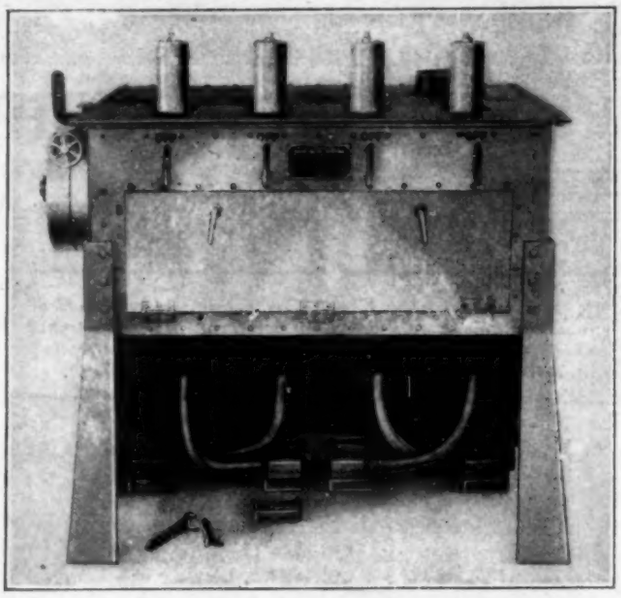
BEACH NO. 1 LAPPING MACHINE

Swing, 10 in.; diameter of spindle, 1⅛ in.; length of bronze-bushed spindle bearings, 2 in.; diameter of faceplate, 6 in.; driving cones, beveled steel and leather faced; bearings on spindle and driving cones, ball thrust.

up to 10 in. in diameter. It is fitted with bronze and ball thrust bearings, ample provision being made for lubrication. A friction drive is used, this being accomplished by means of beveled steel and leather-faced cones. The knee-operating feature gives instant control and leaves the operator's hands free to manipulate the work. The machine is regularly furnished with a pull countershaft and faceplate ready to be fitted to the chuck, but can be furnished with either universal-geared scroll chuck or drill chuck.

Pangborn Type "EW" Suction Shell-Cleaning Cabinet

The Pangborn Corporation, Hagerstown, Md., is now marketing the Type "EW" suction shell cabinet sandblast shown in the illustration. The apparatus consists principally of four rotating chucks driven at slow speed for rotating the shell while the blasting operation is in process. The chucks are mounted on ball bearings which are protected from dust and abrasive, the shells being held in a vertical position with the openings pointing downward. Four suction-type projectors are arranged below the shell openings, with blast nozzles positioned to project at a slight angle inside of the shell opening. No movement or adjustment of the shells or nozzles is required after the shells are placed in the chucks. The operating handles for the air valves are located in front of each chuck within convenient reach of the operator. The bottom of the cabinet forms a hopper for the abrasive, and supplies this by gravity to the feed boxes located at the front and visible to the operator. The cabinet itself is formed of reinforced steel plate and entirely incloses the operating mechanism, making the cabinet absolutely dustproof. One of the features of the machine is that no catches or other devices are required to hold or rotate the shells other than the chucks themselves into which they are

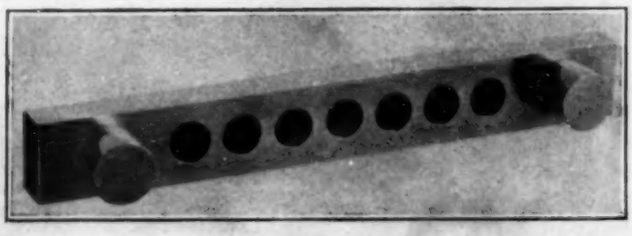


PANGBORN TYPE "EW" SANDBLAST MACHINE FOR SHELL WORK

merely set. This leaves the entire top of the cabinet free and unobstructed, a feature that makes for ease and rapidity of operation. The flow of abrasive can be regulated and the feed boxes are constructed with removable bottoms for ease in cleaning in case foreign material gets into the hopper. The projectors can be adjusted in regard to angle and for vertical and horizontal position.

M. & R. Sine Bar

The M. & R. Tool Co., 59 Mechanic St., Newark, N. J., has recently placed on the market the 3-in. sine bar shown in the illustration. The device is



M. & R. SINE BAR

intended to be used with a perforated angle plate or other similar device, and seven holes are provided in order to attach the bar to the plate. The bar is lapped to size and guaranteed for accuracy.

RECONSTRUCTION NEWS

TIMELY INFORMATION *for* LIVE MACHINE SHOPS

Washington, D. C., Nov. 16, 1918.—The following statement was made by B. M. Baruch, chairman of the War Industries Board, on Nov. 8:

"For some time to come Government contracts must continue on a wide scale. This circumstance applies to a considerable share of present contracts.

"As the demand for raw materials is lessened by the reduction of war requirements and the cancellation of war contracts, if and when such cancellations be made the raw materials so made available will be released and allocated by the War Industries Board for use in supplying civilian and export demands, which through curtailment have been held in check during the war. In addition to the ordinary commercial requirements there will be a heavy flow of materials thus released to supply the demand for the great reconstructional work required by the European countries.

"At the same time there is to be a gradual lifting of the restrictions and curtailments that have been imposed upon industry by the exigency of the war so as to allow as promptly as possible free flow of all supplies into peace channels.

"The War Industries Board will continue to exercise its functions until the peace treaty is signed, to the end that the readjustment of the matters on which it has been acting may be made in as orderly a manner as possible.

"A committee named by the President has been and is now at work to devise the best mechanism to bring about the adjustments from a war to a peace basis. The report of the committee may take the form of suggested legislation.

"The whole effect of the readjustment plans will be to bring about necessary changes with as little dislocation as possible and the full opportunity for all to benefit as in the past by individual ingenuity, vision and fair dealing."

* * *

Under the circumstances it is perhaps advisable to make an explanation of what is said to be the true political situation in Washington concerning reconstruction measures, so that business men may understand what confronts them in preparing to place industry upon a peace basis, and take such precautions in presenting their views to Congress as may be deemed feasible.

In the first place doubt has crept up during the past week in well-informed legislative circles in Washington that the Senate will consent to confirm the appointment of Bernard M. Baruch, chairman of the War Industries Board, as a member of a reconstruction commission in case the so-called administration plan of revamping the Overman bill giving reconstructional powers and duties to the War Industries Board is carried through.

If a forced vote were obtained from the present Democratic Congress it is doubtful whether later on appropriations could be obtained if Mr. Baruch were to have a controlling voice in their expenditure. Doubt is also being expressed in Washington that the Senate will permit the creation under any bill which Congress passes of reconstructional powers and duties in the hands of Vance McCormick, chairman of the War Trade Board, who is also chairman of the Democratic National Committee, and who has also been mentioned as a possible presidential appointee upon a reconstruction commission. These doubts extend to the members and committees and machinery in part of the two bodies mentioned.

* * *

It should be pointed out that these doubts are not personal to the gentlemen mentioned nor to their associates; and it should also be pointed out that senators in many instances share the publicly expressed opinion of business men concerning the good work the war agencies under the direction of Mr. Baruch and Mr. McCormick have done in behalf of business, and that a measure of control of industry immediately following the war will be necessary for a time if some business organizations are not to obtain all the coal, raw materials, transportation, foreign-shipping space, etc., they want, permitting others less fortunate to go without.

But while these facts are recognized a storm of opposition has been aroused in the Senate because Mr. Baruch has issued the above statement in which he has said that reconstructional plans will possibly come forth in the near future "in the form of suggested legislation." Mr. Baruch is known, just prior to the issuance of this statement and just after a visit to the White House, to have told his colleagues in the War Industries Board that the members and committees of that board would play a leading part in reconstruction. Apparently a number of senators were not previously taken into consideration and conference, and this has added dissatisfaction to a senatorial state of mind which

has become more and more disgruntled during the past few months.

That Mr. Baruch has made many enemies, some of them said to be very close to the presidential cabinet circle, is now out in the open in Washington. On the other hand equally well-informed Washingtonians are pointing out that a large proportion of the opposition to granting reconstructional powers to Mr. Baruch and Mr. McCormick arises not so much from opposition to these gentlemen and the war agencies with which they have been associated as from opposition to the President.

The intimation is now current that the Republican senators as well as the Democratic senators who are now expected to come out in the open against the White House are likely to force an extra session of Congress just after March 4 by holding up some of the big appropriation bills such as the Post Office bill. As the country will still be on a war basis next spring it is said that no effort will be made to hold up either the War Department or Navy Department bills, but there are many other bills which provide not the sinews of war but the sinews of peace which can be held up to force an extra session.

In these circumstances senators now in Washington who are favorable to quick passage of necessary reconstructional measures so that the business interests of the country may be able to get back upon a peace basis without an interregnum believe that business men would do well to take an active interest in what is going on at Washington in this respect before the prospect of the passage of the bills gets so muddled because of politics that they are beyond straightening out. By the time this is published most of the members of the Senate and House will be back in Washington, and then it is expected there will be quickly laid plans to defeat the purposes of the President or, to take the more hopeful view, plans will be made to put business on its feet.

* * *

The convention of the War Service Committees to be held at Atlantic City the first week in December under the auspices of the Chamber of Commerce of the United States is for the primary purpose of planning reconstruction. The original plans called for a war-emergency and reconstruction conference, but since the war is ended it is stated everything will be centered on reconstruction. The men who gather at this convention, speaking for their own industries, will be able to present information that will be of benefit to the Government in working out any reconstruction plans it may have in mind.

War-service committees will come together in 35 related groups. The plan is to form a great national advisory council, with a representative from each of these groups. This council in turn will name a small executive committee, which will speak for industries represented in all war-service committees.

Some of the men who have been asked to speak at Atlantic City are President Wilson, Secretary McAdoo, Secretary Baker, Charles M. Schwab, James A. Farrell and John D. Rockefeller, Jr. The heads of divisions of the War Industries Board will meet with each related group. The chamber is now seeking in all of the 35 industries represented in the groups the strongest man it can find to speak to his industry in addition to the head of the War Industries Board.

The War Service Committees will meet one day ahead of the conference to discuss a number of subjects dealing with reconstruction on which they will be expected to report to their related groups, which in turn will report to major groups and will be discussed in the general sessions.

One of the pressing questions which will be taken up is that of cancellation of war contracts. The War Service Executive Committee of the chamber has written a letter on this subject to President Wilson suggesting an early announcement of a comprehensive scheme for meeting the emergency and preventing the possibility of a panic.

The letter follows:

CHAMBER OF COMMERCE OF THE UNITED STATES OF AMERICA
Nov. 9, 1918.

The President,
White House,
Washington, D.C.

Sir: The War Service Executive Committee of the Chamber of Commerce of the United States has been in session here this week giving special consideration to questions which are coming from business interests in every direction as to the cancellation of war contracts and the transfer from war to peace conditions. It has learned with much satisfaction of the thought which is being given to this problem and the plans you have in mind for maintaining centralized control during the period of readjustment.

As you are doubtless aware the cancellation of contracts by some Government agencies during the last 10 days has caused a great deal of apprehension and disturbance, the extent of which, fortunately, has not attracted public attention because the war news has so greatly overshadowed it. The developments incident to the cancellation referred to indicate the difficulties we will have to face unless the transition is gradual and the vast labor and financial interests involved are most carefully safeguarded. The stoppage of work in the small number of instances where steps have already been taken is causing uneasiness among the banks, which in almost every case are extending credit to the contractors, and is likewise affecting the credit of large numbers of subcontractors who are supplying materials to the principals.

The alarm apparent in other industries is however the most serious incident of the matter, as indicated by the information reaching our committee from various business interests. The statements of plans proposed to deal with these difficulties now being made public will have a tendency to allay this apprehension, but our committee desires to suggest the advantage of the earliest possible announcement of a comprehensive scheme for meeting the emergency and preventing the possibility of panic.

In creating new machinery or adjusting that now in existence full consideration will no doubt be given to the necessity of harmonizing the policies of the various departments engaged in war work in their action on the cancellation of contracts and the matters affected thereby.

It seems to us that it is possible to work out certain common principles which should obtain in all Government departments in affecting settlements on contracts now to be stopped and adjusting them on a fair basis. We realize of course that no policy can be fixed which will apply in all cases. Nevertheless we believe that the principles recognized in all departments should be consistent, so far as possible. If one bureau or department follows its own ideas and another pursues a different course it seems to me that it will lead to endless controversy and confusion. For this reason we believe the agencies set up in the various bureaus and departments to deal with the question should be controlled by some common authority in order to prevent great difficulty.

Pending the development of an adequate organization we earnestly hope that a clearance committee may be appointed

at once, to which will be referred all proposals to cancel contracts, with instructions to all departments that cancellations shall not be made without the approval of this committee, in order that raw materials which will be released by the stoppage of war production may be allocated to industries able to use them immediately for peace-time needs. We are of the opinion that war contracts should not be canceled until provision is made for the absorption of these raw materials.

Another serious situation is that of the protection of values in stocks of raw materials on hand, which a very large number of manufacturers engaged on Government work purchased at the high prices that have prevailed and are now carrying. If through sudden cancellations these stocks are now freed and no arrangement is made for their utilization in some other direction there is likely to be a very great decline in prices, temporarily at least, until demands in other directions assert themselves.

We are sure from the statements already made public that most of these matters are receiving earnest consideration, but the inquiries made of our committee have been so general and insistent that by direction of the committee I am venturing to convey to you thoughts concerning some phases of the problem which are causing general concern among business men just now.

Chamber of Commerce Convention Likely To Be Formative

At the big forthcoming convention of the Chamber of Commerce of the United States to be held at Atlantic City on Dec. 3-6, the various war-service committees representing all branches of American industry will consider readjustment problems and attempt to formulate their judgment on the best national procedure for reconstruction. This will afford the industries an opportunity to lay down nonpartisan and common-sense conclusions, which should be very effective with Congress or the War Industries Board, whichever of these bodies has the prevailing influence in reconstruction work. This convention is to be divided into groups of committees, of which there are 10 major groups and 35 related groups. Major group No. 3 relating to iron and steel and the following related groups are of interest to machine shops: Related group No. 7, gas motors, automobiles, engines and the like; No. 8, steel and iron production, rolled and drawn; No. 9, steel and iron products, fabricated or manufactured; No. 10, steel and iron products, cast; No. 11, machinery, tools and power equipment; No. 12, hardware.

How Contracts with the Government Will Be Handled

Mr. Baruch on Nov. 11 made the following statement regarding the termination of war contracts:

The following memorandum was issued by Maj.-Gen. George W. Goethals, Assistant Chief of Staff and Director of Purchase, Storage and Traffic, regarding arrangements that have been devised for the termination of war contracts in the public interest where such termination is found necessary:

1. Standard Contracts Provisions on "Cancellation and Termination Before Completion."—After very careful consideration the Superior Board of Contract Review approved and the Director of Purchase, Storage and Traffic issued supply circular No. 88, dated Sept. 7, 1918, containing standard contract provisions, including provisions on "Cancellation and Termination Before Completion." These provisions cover cancellation for contractor's default, termination in the public interest, assignment of subcontracts and taking possession of contractor's plant. Referring particularly to termination in the public interest supply circular No. 88 establishes definitely the payments to be made by the United States in the event of such termination for articles completely manufactured at the time and for raw materials, articles in process of manufacture and the contractor's outstanding obligations incurred in good faith in connection with the performance of the contract. Provision is also made for payment by the United States to the contractors of a fair amount on account of depreciation or amortization of plants, facilities and equipment provided by the contractor for the performance of his contract. In return the United States is released from its obligation to take the remaining articles not manufactured specified in the contract and to pay anticipated profits to the contractor on the unfinished portions of the contract. The contract provisions have been worked out with considerable care to meet the situations presented both by fixed-price contracts and cost-plus contracts. The provisions applicable to fixed-price contract are found on pages 5 to 8, inclusive, of supply circular No. 88, and the provisions applicable to cost-plus contracts are found on pages 17 and 18 of this supply circular.

2. Contracts Not Providing for Termination in Public Interest.—A large number of contracts now outstanding do not specifically provide for termination in the public interest. If it becomes necessary to terminate such contracts in the public interest it is assumed that the parties will generally desire to adjust their rights on the basis of the equitable principles established by the contract provisions contained in supply circular No. 88 referred to above.

3. Contracts Providing for Continuing Deliveries.—Supply circular No. 97 sets forth contract provisions applicable to contract providing for continuing deliveries, including provisions for termination of the contract in the public interest. These provisions apply directly to contracts executed under the provisions of supply circular No. 97, and it is assumed that the parties will desire to use them in connection with the termination of analogous contracts providing for continuing deliveries even though they do not contain specific provision on the subject of termination in the public interest.

4. Board of Contract Adjustment.—In order that questions arising under the contract may be promptly and fairly settled there has been created a Board of Contract Adjustment. Supply circular No. 88 contains on page 12 provisions on "Adjustment of Claims and Disputes" providing in effect that any claims, doubts or disputes which may arise under the contract and which are not disposed of by mutual agreement may be determined by petition of the contractor to the Secretary of War or his duly authorized representative or representatives. In order to adjust such claims, doubts or disputes as may be thus referred to the Secretary of War and also other claims, doubts or disputes which the contractor may desire to refer directly to the board a general order has been issued creating the Board of Contract Adjustments and defining its powers and duties. This board will consist of three members having the rank of lieutenant-colonel, and will conduct hearings, appoint examiners and reach decisions promptly and on principles of equity without the delays and technicalities which frequently attend litigation in the courts. If a contractor is dissatisfied with the decision of this board he may appeal to the Secretary of War. It is assumed that in most instances contractors will be satisfied with the decisions thus rendered and will not find it necesary to avail themselves of their right to resort to the Court of Claims.

Relaxation of Priorities Restrictions

On Nov. 12 the Priorities Commissioner, Judge Parker, issued an announcement modifying certain sections of various priority circulars. Activities along building construction lines are largely released and the limitations on the production of building materials are removed. The following details are of interest to machine shops:

Section 3.—Restrictions upon industries and manufacturers in their production of, or in their consumption of

materials for, commodities hereafter in this section enumerated, as such restrictions are expressed in orders and circulars issued by this division, are hereby so modified that such restrictions for the respective periods provided for in such several orders and circulars shall be less than the restrictions provided for in such orders and circulars to the extent of 50 per cent. of such restrictions; that is to say, where the industry has been curtailed for a stated period a certain percentage of its production or in its consumption of materials such curtailment for such period is hereby reduced to the extent of one-half of the curtailment expressed in such order or circular. To illustrate: Where an industry for the last four months of 1918 has been curtailed 25 per cent. such curtailment is hereby changed to 12½ per cent. for such period; where it has been curtailed 40 per cent. such curtailment is hereby changed to 20 per cent., and where it has been curtailed 50 per cent. such curtailment is hereby changed to 25 per cent. The commodities referred to are as follows: Agricultural implements and farm-operating equipment, including tractors; road machinery; coal, coke and wood-burning cooking and heating stoves and ranges; gas ranges, water heaters, room heaters, hot plates and appliances; oil and gasoline heating and cooking devices; electrical heating and cooking devices and appliances; black galvanized and enameled-ware and tin-plate household utensils; refrigerators; ice-cream freezers; washing machines; clothes wringers; family sewing machines; electrical vacuum cleaners; metal beds, cots, couches, bunks and metal springs for same; boilers and radiators; baby carriages; corsets; bicycles; electric fans, including motors; builders' hardware; padlocks; step ladders; scales and balances; rat and animal traps; talking machines, including motors and accessories; talking-machine needles; clock-watches and clocks; watch movements and watch cases; hand stamping and marking devices; safes and vaults; lawn mowers; pottery; pocket knives and similar products; linoleum; rag-felt floor covering; sporting goods; glass bottles and glass jars; tin plate; pianos, including piano players, automatic pianos and parts; pneumatic automobile tires; passenger automobiles, and cash registers. Nothing herein contained shall be construed to release any industry or manufacturer from the strict observance of the rules and regulations of the Conservation Division of the War Industries Board as applicable to such industry or manufacturer.

WHOLESALE AND RETAIL DEALERS

Section 4.—Wholesale and retail dealers in raw materials, semifinished and finished products are hereby relieved from the obligation to give and require pledges relating to such commodities, notwithstanding any provision for pledges in any order or circular heretofore issued by the Priorities Division, and notwithstanding any stipulation in any pledge that they will require pledges from those who buy from them for resale; provided, however, building materials and other products shall not be sold and delivered for use in connection with any nonwar construction projects save those for which no permit or license is required under priority circular No. 21, as revised by Section 1 hereof, or those authorized by permits or licenses issued in pursuance of said circular; provided, further, manufacturers will continue to give pledges in accordance with the terms of orders and circulars heretofore issued, and comply with all pledges heretofore or hereafter given, save that they are hereby relieved from the provisions in such pledges as require manufacturers to exact pledges from those who buy them for resale.

Section 5.—The Priorities Division of the War Industries Board will as far as practicable assist industries in procuring materials, fuel, transportation and labor to enable them to increase their operations to normal limits as rapidly as conditions may warrant. Precedence must however be given to stimulate and increase the production of cargo ships and supply the requirements of the Army and Navy of the United States as well as to provide for this nation's proper proportion of the enormous volume of materials, equipment and supplies as shall be required for the reconstruction and rehabilitation of the devastated territories of Europe. Precedence must also be given to such activities as will tend to stimulate the production of foods and feeds, coal, natural gas, oil and its products, textiles and clothing and minerals, and to provide for deferred maintenance, additions, betterments and extensions of railroads, telegraph and telephone lines and other public utilities, and to permit and stimulate the intensive development of inland waterways.

The War Industries Board requests and with confidence shall expect to receive the continuance of that wholehearted coöperation and support of the industries of this nation which it has heretofore enjoyed, and which will make possible the success of so much of the industrial adjustment program covering the period of transition from a war to a peace basis as it is called upon to administer.

EDWIN B. PARKER, Priorities Commissioner.

Approved,

BERNARD M. BARUCH, Chairman War Industries Board.

Washington, Nov. 11, 1918.

This change in priorities should have its effect on the machine-tool industry by making it possible for the railways to buy some of the machine tools which they have needed for these many years. Just how far these orders will actually be placed probably depends largely upon Mr. McAdoo, but it is hoped that he will see the necessity of not only getting the railways in the best possible condition, but also of helping to stabilize the industries which are to some extent dependent on the railways. The policy has been to let each railway order its own equipment, the same as before, and while this may have some advantages there can be no question as to the advisability of having a clearing house for all railway supplies to act as a stabilizer during the period of readjustment.

The need of a clearing house with branches covering all sorts of activities can be shown by an occurrence with regard to machine tools. The shipbuilding contract of the Bethlehem Steel Co. on the Pacific Coast was canceled recently, and this in turn made unnecessary many machine tools that had been ordered. Fortunately, for the machine-tool industry there is a level-headed man in Washington who has been helping to guide the destinies of our machine-tool equipment during the past year and who acted as the clearing house in this instance. His knowledge of the machine-tool needs of the various activities made it possible for him to shift many of the machines that would be released by the cancellation of the ship contract to other lines of industry. This avoided disturbance to the builders of the machines, which were nearly all special, and prevent the worst conditions.

There is no doubt of the need of this supervision and direction being continued for several months, perhaps even longer, for there are under way many special machines that are utterly useless in ordinary times. These conditions are already being carefully considered, and while no announcement can be made at this time it is encouraging to know that the machine industry is being well represented.

Among the points being considered is the equitable settlement of compensation for machines that are under way and that have little or no market value on account of being specially designed for war work of different kinds. An earnest attempt will be made to prevent any unnecessary expenditure and at the same time to be perfectly fair to the manufacturers and to prevent the necessity of laying off men in large quantities. Some cancellations have already been made which are

more or less disturbing, but it is hoped that a definite plan will be announced in the very near future as to the policy to be pursued.

Plans are also under deliberation for taking into account the expenditures made by various machine builders in enlarging their plants far beyond any expectation of peace-time requirements in order to meet the needs of the war program. These conditions, it is pointed out, should be carefully considered in connection with any tax bills that may be framed. For while no machine builder wants to dodge his legitimate taxes it is obviously unfair to tax him for a plant he does not need and which was built especially to help the country in its need. Any exemption made should depend upon the use of the increased facilities, so that should normal business demand the larger plant the tax should be applied to it all.

Unemployment Insurance

The question of unemployment is also being carefully considered, and some form of the British Unemployment Insurance is likely to be recommended. It is of course hoped that unemployment can be avoided, but it is well to be prepared in case some hitch, legislative or otherwise, should occur. The trouble in this direction, if it comes at all, is not so likely to be with the returned soldier as with the men and women now employed in strictly munition work. Strictly war work must stop as soon as it can be done without throwing the whole business machine out of gear, for it is obviously uneconomic to pile up munitions which will not be needed. But unemployment must be prevented at all costs.

The increased amount of material to be allotted to the automobile field will help in several ways, as it will absorb a goodly proportion of the workers who are now in plants on war work. Machine builders can also begin to plan for the production of their regular line of machine tools or other machinery, and in this connection it is well to bear in mind that staple machines, such as standard types of lathes and planing, milling and drilling machines, always have a market, even though the sales fluctuate and demand may be below normal for a time.

It is gratifying to note that much activity is already under way making for the gradual changing of industry back to a peace basis. The community war labor board is being utilized to find out local-community needs. Some labor will of course be shifted, but coöperation by manufacturers and others will make the work sure and comparatively easy. Sunday work and overtime will be discontinued at once, so far as possible, without disrupting conditions. They are abnormal and, as Felix Frankfurter says, "We must fasten our minds on normal conditions."

The process of mobilizing industry has been reversed, and questionnaires are already being sent out to find out the best methods of getting back to normal. In mobilizing industry the procedure was to start with the requirements of the Army and the Navy, to go through the War Industries Board and then to the Labor Board. This is now reversed, and action starts with the Labor Board, goes through the War Industries Board and then to the Army and the Navy to see how their program can best be curtailed. While this may not apply to the battleship program, in general it is said to be the routine followed, and shows the kind of labor that can best be released and that can most easily find its way back into normal channels. In each case the local information to be obtained from the community war labor boards is utilized.

A Salvage Bureau

The suggestion has been made by a well-known Army officer that a centralized salvage bureau be established to handle all matters relating to machinery and other supplies which would be better completed than left unfinished. This would also apply to such material as is already completed but for which there is not likely to be a demand. By having this matter handled as a department of the existing Government agencies instead of leaving it to the tender mercies of Congress much can be done to stabilize manufacture and also to obtain some return for the war expenditures that must still be made. In the matter of machine tools, for example, a clearing house of this kind could find a market for many large special tools during a period of perhaps four or five years and thus save many thousands of dollars over the usual way of letting speculators do the work.

Already salvaging bureaus are disposing of material ordered but not needed, as in the case of aircraft and which was mentioned some time ago. The need of some good organization for this purpose is proved by the reports, already rife, concerning the flock of business buzzards which is hovering over the remains in the hope of reaping a harvest. Material of this kind seldom has very much use except as scrap, but care should be exercised to see that it is not sold at a bigger sacrifice than necessary. Every dollar saved in salvage means a dollar less taxes later on.

Study of Employment Problems

Those who are not absorbed in politics or personal ambitions are earnestly studying the problems of employment during the period of readjustment. This period will tax the United States Employment Service to its utmost, and it is absolutely essential to at least maintain its present efficiency and morale. Any letting down will be fatal to the service it can render. It is too new to be very efficient, which is all the more reason for keeping it free from the meddling that has been in evidence in some quarters. Incompetency in high places is inexcusable at this time, even on the ground of looking after political friends or relatives. The employment service must be improved, must get good men and women in responsible positions, even if it is necessary to pay more than the regulation Government salaries to get them. And no politics or family relations in Washington or elsewhere should be permitted to stand in the way.

Handle with Care—Don't Drop

The editorial supplement inserted in this week's *American Machinist* has to do with the important subject of reconstruction and should be carefully studied by all who are interested in the future of the machinery industry.

Personals

C. W. Stephens has been made manager of sales of the Detroit Twist Drill Co., Detroit, Mich., to succeed **Nelson J. Smith**, who becomes assistant to the president.

E. L. Evans has been appointed superintendent of plant No. 1 of the Bound Brook Oil-less Bearing Co., Bound Brook, N. J. He was formerly chief inspector of the plant.

W. G. Dwyer, of McLeod & Co., 28 Dalhousie Sq., Calcutta, India, will be in this country early in 1919 to place orders and make arrangements for machinery, machine tools, etc. Interested parties may send their catalogs to the office in Calcutta or to W. G. Dwyer, in care of J. E. Sitterley, 47 Broadway, New York.

A. G. Jones, for many years with the Windsor Machine Co. and later with the National-Acme Manufacturing Co. of Windsor, Vt., has gone to the Cone Automatic Machine Co. of Windsor, Vt., to become general sales manager.

Edwin F. Church, Jr., formerly professor of machine designing in West Virginia University, Morgantown, W. Va., is now professor of mechanical engineering at the Brooklyn Polytechnic Institute, Brooklyn, N. Y.

Roy B. Fehr has resigned as assistant professor of mechanical engineering at the Pennsylvania State College, State College, Penn., and is now assistant physicist for the Recording and Computing Machine Co., Dayton, Ohio.

M. R. Walton is now employed as mechanical engineer with the Firestone Steel Products Co., Akron, Ohio.

Ralph E. Carpenter is now director of service for the Aluminum Castings Co., Cleveland, Ohio. Mr. Carpenter was formerly sales manager for the Taft-Peirce Manufacturing Co., Woonsocket, R. I.

J. B. Hamilton, secretary and treasurer of the Wickes Machinery Co., Jersey City, N. J., has become president of the Hamilton Machinery Co. of the same city. The Hamilton company deals in machine tools, motors and other equipment.

John G. Shirley is now production manager of the SKF Ball Bearing Co., Hartford, Conn. He was at one time assistant works manager of the Gilbert & Barker Manufacturing Co., Springfield, Mass.

L. G. Buske, formerly connected with the Shaw Electric Crane Co., Muskegon, Mich., as directing engineer and service man, is at present identified with the Champion Engineering Co., Kenton, Ohio, crane builder.

Vincent Bendix of the Eclipse Machine Co., Elmira, N. Y., is now located in the company's Chicago office at 327 South La Salle Street.

Joseph Berg, at one time mechanical engineer of the Champion Ignition Co., Flint, Mich., is now manager of the aircraft division of the same company.

O. C. Bornholt is now mechanical engineer of the Buick Motors Co., Flint, Mich. He was formerly factory manager of Holley Brothers Co., Detroit, Mich.

Obituary

Lieut. Angus Douglas Gray, vice president and secretary of the Gray Machine Tool Co., Inc., Buffalo, N. Y., died of pneumonia Oct. 25. He was born Dec. 11, 1897. He joined the Canadian Expeditionary Forces as a member of the Fourth Canadian Machine Corps in July, 1915, and was wounded at the battle of the Somme, July, 1916, and again at the battle of Fresnoy, May, 1917. For services rendered in this battle he received the Military Cross. He was transferred to the Canadian Expeditionary Forces reserves in January, 1918, and then became connected with the Gray Machine Tool Company.

Business Items

The Lincoln Electric Co., Cleveland, Ohio, has opened a branch office at 507 Union Arcade Building, Pittsburgh, Penn., with **H. L. Eicher as district manager.**

The Modern Machinery Co., 25 Church St., New York, has opened a branch house at 164 Market St., Newark, N. J.

The Cleveland Galvanizing Works Co., Cleveland, Ohio, has changed its name to the Chain Products Co. The company was founded in 1886 by H. H. Hodell of Cleveland. There are no changes in the management, personnel or policy, F. G. Hodell remaining as president, H. H. Hodell vice president and W. F. Schneider secretary.

The Hooker-Mossberg Corporation has been organized in Massachusetts to take over a large contract for the manufacture of airplane parts for the Government. The officers are Leslie E. Hooker, president and treasurer; Frank Mossberg, vice president and general manager, and Chester A. Miller, secretary. The factory is at Attleboro, Mass.

Clark W. Parker and **Wyman C. Parker** have disposed of all of their stock in the Parker Rust-Proof Co. of America, and Clark W. Parker has resigned as a director of the corporation and is no longer connected with it. Their stock interest has been acquired by A. V. Foster or the firm of Spitzer, Rorick & Co., Toledo, Ohio.

Victor Tool and Supply Co., 95 East Larned St., Detroit, Mich., incorporated for $75,000, has been organized. The officers are George W. McLean, vice president; R. M. Hearns, treasurer; V. M. Gunderson, secretary, and Harry W. West, president and general manager. Messrs. Hearns, Gunderson and West are officials of the Victor Screw Company.

The Chicago Pneumatic Tool Co., Chicago, Ill., announces the appointment of A. G. La Pierre as traffic manager and F. O. Southbrook as manager of the order and production department. Their headquarters will be in the home office of the company, Fisher Building, Chicago.

The Kearney & Trecker Co., manufacturer of Milwaukee milling machines, is now installed in its new branch sales store at 631 West Washington Blvr., Chicago. W. H. Allen is in charge.

Trade Catalogs

Grinding Machines. Draper & Hall Co., Middletown, Conn. Circular. Pp. 4; 8½ x 11 in. Several illustrations are given of grinding machines for various kinds of work together with description and specifications.

Oil-less Bushings. Bound Brook Oil-less Bearing Co., Bound Brook, N. J. Booklet. Pp. 32; 6 x 9 in. Many halftone illustrations are given showing the different types of bushings and their various applications. The booklet is descriptive throughout.

Heat Treating Furnaces. Tate-Jones & Co., Inc., Pittsburgh, Penn. Catalog. Pp. 16; 8½ x 11 in. This catalog gives many illustrations of heat-treating furnaces of large capacity and several pages are devoted to furnace building.

S. A. E. Data Sheets. Morse Chain Co., Ithaca, N. Y. Loose-leaf folders. Pp. 18; prepared to fit and bind in S. A. E. folders. In addition to showing the applications of the Morse rocker-joint silent chain as used on many engines and cars, many illustrations and line cuts with data tables explain and give the information the engineer requires for estimating, installing and operating front-end chain drives. The booklet should be of use and interest to automotive engineers and will be sent free to all inquirers.

Pumps for Handling Coolant. The Fulflo Pump Co., Banchester, Ohio. Circular. Pp. 12; 3½ x 8 in. Several illustrations are given as well as a description and illustration of a machine-tool pump and a grinder pump. It also gives letters of recommendation from users.

Tanks. Walter A. Zelnicker Supply Co., 325 Locust St., St. Louis, Mo. Bulletin No. 252. Pp. 12; 3½ x 8½ in. Gives the trade number, capacity, sizes and weight of storage, pressure, car, wooden and miscellaneous tanks for most every requirement; also gas holders and drums. It will be sent free to any one interested.

Twist Drills, Milling Cutters and Reamers. Lincoln Twist Drill Co., Taunton, Mass. Catalog No. 10-A. Pp. 160; 5 x 7½ in. It gives illustrations, sizes, numbers, prices, etc., of arbors, bits, countersinks, cutters, drills, end mills, hollow mills, mandrels, reamers, saws, sleeves, sockets, etc. Tables and useful information on screw threads, speeds and feeds, etc., are also given.

Clover Grinding Compounds. Clover Manufacturing Co., Norwalk, Conn. Booklet (third edition). Pp. 12; 3½ x 6½ in. It contains suggestions for valve grinding, grinding pistons into cylinders, grinding a crankshaft into its bearings, running together gearing and lapping. Two pages are taken up with boosts from users.

Wetmore Thread-Milling Hobs. Wetmore Mechanical Laboratory Co., Milwaukee, Wis. Leaflet No. 51; 8½ x 11 in. It describes and illustrates Wetmore thread-milling hobs for shells, which are made in sizes for use on various thread-milling machines used in shell production.

Wetmore Taps for Shells. Wetmore Mechanical Laboratory Co., Milwaukee, Wis. Leaflet No. 52; 8½ x 11 in. It is devoted to solid and expanding taps, solid taps being shown in 1½, 2 and 2½ in. sizes, and 1.379, 1½ and 2½ in. sizes of the expanding or adjustable type. The taps shown are similar to those in Canada and the United States for sizing fuse-hole threads of shells.

New Calendar. The Toledo Bridge and Crane Co., Toledo, Ohio, is getting out a 1919 calendar, which will be ready for mailing Nov. 15. It will be sent to anyone free upon request.

Oxyacetylene Cutting and Welding Apparatus. Great Western Cutting and Welding Co., 884-886 Folsom St., San Francisco, Calif. Catalog No. 11. Pp. 20, 7 x 10 in. It illustrates and describes the cutting and welding apparatus for various kinds of work. Other illustrations, together with a description of torches and regulators, are also given.

Some Sand Blasting Fallacies. United States Silica Co., 122 South Michigan Ave., Chicago, Ill. Booklet by R. R. Shuman. Pp. 16; 5 x 8 in. This booklet explains "Flint Shot" for sandblasting various materials.

Forthcoming Meetings

The American Society of Mechanical Engineers will hold its annual meeting in New York, Dec. 3-6. The secretary is Calvin W. Rice, 29 West 39th St., New York.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

The Chamber of Commerce of the United States will sponsor a big convention of war-service committees in Atlantic City, N. J., Nov. 19 to 21, 1918. The following classes of manufacturers will be represented: Gear, wire fencing, jute, store fixture, furniture, textile machinery, foundry equipment, sporting gun and ammunition, warm-air register, furnace, metal hospital furniture, ladder, laundering machinery, naval stores, oil refining and lard substitute, textile pin, safety pin, water-purification apparatus, dandy rolls, stereopticon machine, power pump, gasoline and kerosene vapor lamp, fluorspar, egg case and egg filler, chuck, automatic office device, bobbin and shuttle, germicide and insecticide, clay, oil cloth, bottle and jar cap, brush, button, sensitized photograph paper, tent and awning.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

The New York State Industrial Safety Congress will hold its third annual session at the Hotel Onondaga, Syracuse, N. Y., Dec. 2-5. Particulars may be obtained from Louis Wiard, 230 Fifth Ave., New York.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadephia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

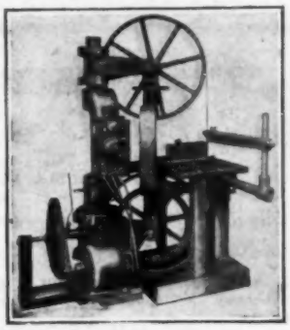
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Band-Saw, No. 3 Metal

E. C. Atkins & Co., Inc., Indianapolis, Ind.

"American Machinist," Oct. 31, 1918

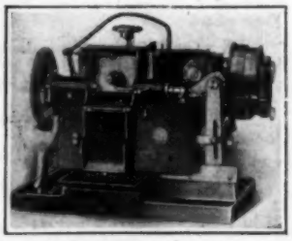


It is claimed that this machine will average from two to three times as much work as any hacksaw machine and that it will at least equal if not beat the rapidity of cutting of a circular saw. It is also claimed that the cost of blades is considerably less than that for milling cutters, another advantage being that the thickness of the band-saw is only about $\frac{1}{16}$ in., which is about one-half the thickness of a hacksaw blade and from $\frac{1}{4}$ to $\frac{1}{12}$ the thickness of metal milling saw blades. A positive automatic stop is connected with the movable vise jaw, which stops the machine as soon as the teeth have passed through the work, a feature that is said to overcome blade breakage.

Gear-Cutting Machine, 4-In. Spur

Waltham Machine Works, Waltham, Mass.

"American Machinist," Nov. 7, 1918

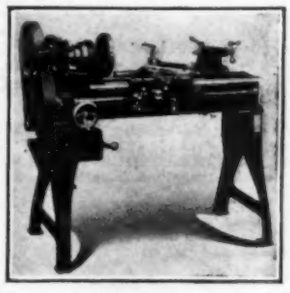


Largest pitch diameter of work, 4 in.; coarsest pitch cut, 16; speed of countershaft, 675 r.p.m.; diameter of tight and loose pulleys, 6 in.; width of belt, 2 in.; size of pan base, 28 x 18 in.; weight, 610 lb.; weight of countershaft, 65 lb.; diameter of cutter arbor, $\frac{1}{2}$ in.; standard dimensions of cutter, $1\frac{1}{4}$ in. diameter, 0.20 in. thick, with $\frac{1}{2}$-in. hole; largest cutter that can be used with full capacity of the machine, $1\frac{3}{8}$ in.; diameter of index, 10 in.; standard number of divisions in index, 120; divisions obtained with 120 index, 8, 10, 12, 15, 20, 24, 30, 40, 60, 120; strokes cut with No. 1 cam 0.5 to 0.8 in.; strokes cut with No. 2 cam, 1.1 to 1.75 in.; strokes cut with No. 3 cam, 1.87 to 3 in.

Lathe, 10-In. Motor-Driven

Sebastian Lathe Co., Cincinnati, Ohio

"American Machinist," Nov. 14, 1918



Swing over bed, 11 in.; swing over carriage, $7\frac{3}{4}$ in.; length of bed, 4, 5 or 6 ft.; front-spindle bearing, $1\frac{7}{16}$ x $2\frac{1}{2}$ in.; hole through spindle, $\frac{3}{4}$ in.; three-step cone pulley for $1\frac{1}{2}$-in. belt with diameters of $5\frac{1}{2}$, 4 and $2\frac{1}{2}$ in.; distance between centers with 4-ft. bed, 28 in.; motor recommended, $\frac{1}{4}$ hp., 1200 r.p.m.; weight without motor, 450 lb.; size of tools, $\frac{3}{8}$ x $\frac{3}{8}$ in.; travel of compound rests, $3\frac{3}{4}$ in.; capacity of center rest, 3 in.; centers, Morse taper No. 2; size of drive pulley, 12 x 2 in.; speed of drive pulley, 200 r.p.m.; spindle nose, 10 threads per inch; length of carriage on bed, $13\frac{3}{4}$ in.

Lathe, Precision Bench, "Ideal" No. 3

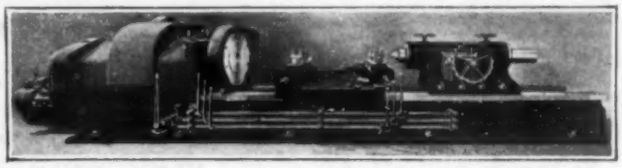
Precision Lathe & Grinder Co., a machine-tool branch of the Ideal Tool and Machine Co., 128-130 Opera Pl., Cincinnati, O.

"American Machinist," Nov. 14, 1918

Cone pulley, three-step for 1-in. flat belt; length of bed, 32 in.; distance between centers, 16 in.; swing, 7 in.; hole through largest collet, $\frac{7}{8}$ in.; swing over compound slide rest, $2\frac{1}{2}$ in.; countershaft speed, 500 r.p.m.; net weight, 360 lb.; height of table from floor, 33 in.; size of oil-pan table, 24 x 44 in.

Lathe, Shell-Turning No. 47

Amalgamated Machinery Corporation, 72 West Adams St., Chicago, Ill.



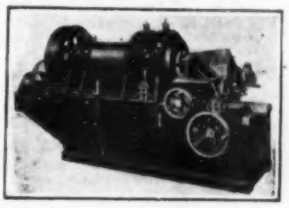
"American Machinist," Nov. 7, 1918

An all-geared machine intended especially for turning operations on shells ranging from 12 to 20 in. in diameter. Floor space, 29 ft. $8\frac{1}{2}$ in. by 5 ft. 3 in.; height, 6 ft. 8 in.; diameter of main pulley, 16 in.; face of main pulley, 12 in.; diameter of pulley for rapid traverse, 16 in.; width of pulley for rapid traverse, 6 in.; speeds, four, gear ratios, 27.3, 31.3, 36.1 and 42 to 1; feeds, 0.070 to 0.50 in. per spindle revolution.

Lathes for 9.5-In. Shells, "Bryant"

R. M. Eddy Foundry Co., Chicago, Ill.

"American Machinist," Nov. 14, 1918



A line of lathes for shell-turning operations, the only difference being the construction of the carriage as required for particular operations. The machine shown is for rough-facing the base end of projectiles. Swing over bed, 32 in.; front-spindle bearing, 16 x 16 in.; rear-spindle bearing, 8 x 10 in.; width of carriage guide, $9\frac{1}{2}$ in.; area of carriage bearing, 397 sq.in.; length of carriage guide, 30 in.; driving clutch pulley, 18 x 6 in.; standard gearing ratios, 9.7, 8.8 and 7.3 to 1; pitch of gearing, 3; floor space, 3 x 10 ft.; approximate weight, 11,000 lb.

Grinding Stand, Wet, Nos. 16 and 17

Valley City Machine Works, Grand Rapids, Mich.

"American Machinist," Nov. 14, 1918

The machine shown is the No. 16, the No. 17 having an extended spindle carrying a wheel for dry grinding. Size of wheel, 16 x 2 x $2\frac{1}{2}$ in.; length of spindle, 24 in.; spindle bearings, $1\frac{1}{2}$ x $5\frac{1}{2}$ in.; diameter of spindle between flanges, $2\frac{3}{4}$ in.; height from floor to center of spindle, $34\frac{1}{2}$ in.; size of pulley, 6 x 4 in.; size of countershaft drive pulley, 12 x 4 in.; tight and loose pulleys on countershaft, 6 x 4 in.; speed of countershaft, 600 r.p.m.; speed of spindle, 1194 r.p.m.; floor space, 14 x 25 in.; shipping weight complete with countershaft, 600 lb.

Thread-Lead Tester

Geometric Tool Co., New Haven, Conn.

"American Machinist," Nov. 14, 1918

The work is held in a V on the sliding carriage. Two measuring points are mounted on the center line of the carriage movement, one point being rigid, while the other is attached to a movable slide. After the device is set by means of a master gage any differences in the work are indicated on the dial, which is provided with two scales giving English and metric readings. Bench space, 8 x 8 in.; height, 10 in.; weight, 17 lb.

Patented Aug. 20, 1918

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$37.60	$37.60
Northern Basic	34.80	34.80
Southern Ohio No. 2	35.80	35.80
NEW YORK, Tidewater delivery		
Penna. 2X	39.55	39.15
Virginia No. 2	41.70	41.70
Southern No. 2	41.70	41.70
BIRMINGHAM		
No. 2 Foundry	34.00	34.00
PHILADELPHIA		
Eastern Pa. 2X	39.15	38.85*
Virginia No. 2	40.50	40.50†
Basic	36.90	36.60*
Grey Forge	36.90	36.60*
Bessemer	39.10	38.80*
CHICAGO		
No. 2 Foundry Local	34.50	34.50
No. 2 Foundry Southern	39.00	39.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	35.40	35.40
Basic	34.40	34.40
Bessemer	36.60	36.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.27	$4.245	$5.25	$4.17	$5.00	$4.27	$5.00
Soft steel bars	4.17	4.145	5.00	4.07	4.50	4.17	4.50
Soft steel bar shapes	4.17	4.145	5.00	4.17	4.50	4.17	4.50
Soft steel bands	4.77	4.995	.....	.....	.....	.....	.....
Plites, ¼ to 1 in. thick	4.52	4.495	10.00	4.42	7.00	4.25	9.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$4.75
Warehouse, New York	4.75	4.75
Warehouse, Cleveland	4.67	4.95
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	5.00	6.52	6.495	6.445	6.42	5.75	6.52	6.445
*No. 26 black	4.90	6.42	6.395	6.405	6.32	5.65	6.42	6.405
*Nos. 22 and 24 black	4.85	6.37	6.345	6.295	6.27	5.60	6.37	6.295
Nos. 18 and 20 black	4.80	6.32	6.295	6.245	6.22	5.55	6.32	6.245
No. 16 blue annealed	4.45	5.72	5.695	5.645	5.62	5.20	5.72	5.645
No. 14 blue annealed	4.35	5.62	5.595	5.545	5.52	5.10	5.62	5.545
No. 10 blue annealed	4.25	5.52	5.495	5.445	5.42	5.00	5.52	5.445
*No. 28 galvanized	6.25	7.77	7.745	7.695	7.67	7.00	7.77	7.695
*No. 26 galvanized	5.95	7.47	7.445	7.395	7.37	6.70	7.32	7.395
No. 24 galvanized	5.80	7.32	7.295	7.245	7.22	6.55	7.47	7.245

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 13%	List plus 25%
Cleveland	List plus 11%	List
Chicago	List plus 13%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price pr 100 lb., in ton lots is:

	Current	One Year Ago
New York	$15.50–19	$14.00
Cleveland	20.00	15.00
Chicago	19.00	13.50

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire*		Cast-Iron Welding Rods	
1/4, 5/16, 3/8, 1/2, 5/8, 3/4 and No. 10	22.10 to 33.00	1/4 by 12 in. long	16.00
		1/4 by 19 in. long	14.00
		3/8 by 19 in. long	12.00
No. 12		1/2 by 21 in. long	12.00
5/16, No. 14 and 1/4			
No. 18		* Special Welding Wire	
No. 20		1/8	33.00
		5/32	30.00
		3/16	38.00

* Very scarce.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.17	4.07	4.17
Toe calk	5.75	4.65	4.32
Openhearth spring steel (heavy)	8.00	8.00	7.50
Spring steel (light)	11.00	11.25	11.75
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	4.77	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
1/8, 1/4, and 3/8	44%	17½%	1/8 to 1¼	33%	17%
1/2	48%	33½%			
3/4 to 3	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD. EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	40%	22½%	1/8 to 1¼	33%	18%
1/2	45%	32½%			
3/4 to 1¼	49%	36½%			

LAP WELD. EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2½ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
1/8 to 3 in. steel butt welded	40%	28%	41%	26%	41.1%	26.1%
3½ to 3 in. steel lap welded	36%	25%	37%	23%	37.1%	23.1%

Malleable fittings. Class B and C, from New York stock sell at list + 15%. Cast iron, standard sizes, 5% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	26.50*	26.00	23.50
Tin in 5-ton lots	78.50	83.00	74.00
Lead	8.05	8.55	7.25
Spelter	10.60	9.50	7.88

* Government price.

ST. LOUIS

Lead	7.75	8.25	7.13
Spelter	10.25	9.25	7.63

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	40.00	38.00	35.00	38.00	36.00	36.00	35.00
Copper wire (carload lots)	35.00	35.00	38.50	35.00	32.00	33.00	33.00
Brass sheets	39.75	39.75	40.00	40.50	35.00	33.50	35.00
Brass pipe	46.00	46.00	43.00	42.50	42.00	44.00	42.00
Solder (half and half) (case lots)	58.00	58.00	39.25	50.50	40.00	56.00	38.00

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$37.75	$29.00
New York	34.25	30.00
Cleveland	38.50	34.00
Chicago	29.50	37.00

SHOP MATERIALS AND SUPPLIES

ZINC SHEETS—The following prices in cents per pound prevail:
Carload lots f.o.b. mill 15.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	18.75	20.00	18.40	20.50
New York	17.00	21.00	17.50	21.25
Chicago	22.00	21.00	21.50	21.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	13.50	14.00
Chicago	15.50	16.25
Cleveland	14.50	16.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland		
	Current 1918	One Year Ago	Current 1918	One Year Ago	Chicago
Copper, heavy and crucible	24.00	22.00	24.00	21.00	21.50
Copper, heavy and wire	22.00	21.00	23.50	21.00	21.00
Copper, light and bottoms	20.50	19.00	21.50	20.00	21.00
Lead, heavy	7.50	4.75	.....	5.50	6.20
Lead, tea	6.00	4.00	7.50	4.50	5.50
Brass, heavy	14.00	15.00	16.50	14.00	18.50
Brass, light	11.00	10.50	12.50	11.00	12.50
No. 1 yellow brass turnings	14.00	16.00	14.00	15.00	14.50
Zinc	6.50	5.75	6.00	5.50	5.80

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, guaranteed over 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.20c.	32.30c.	33½c.

This is the Government price for lots of from 1 to 14 tons.

COPPER BARS from warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York	32.00	40.00
Chicago	38.00	40.00
Cleveland	36.50	39.00

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	70.00	93.00	80.00	96.00	70.00
Commercial	45.00	40.00	23.00	21.00	25.00	25.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	$2.50*	List	$1.25	$1.30	$0.98	$2.00
Hot pressed hexagon	2.50*	List	1.05	1.30	.78	2.00
Cold punched hexagon	2.50*	List	.75	List	1.00	1.50
Cold punched square	2.50*	List	.75	List	1.00	1.50

* List plus.

Semi-finished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	40%	50%
Chicago	50%	45%
Cleveland	50+10%	50%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	30%	40+10%	37%
Larger and longer up to 1 in. by 30 in.	15%	20+ 5%	25—5%

WASHERS—From warehouses at the places named the following amount is deducted from list price.
For wrought-iron washers:
New York..... $2.50 Cleveland..... List Chicago..... $2.50
For cast-iron washers the base price per 100 lb. is as follows:
New York.....$5.00 Cleveland.....$4.25 Chicago.....$4.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	30%	45%	32½%
Larger and longer up to 1 in. by 30 in.	15%	20+5%	20%

COPPER RIVETS AND PURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	List plus 10%	List plus 10%	List plus 10%	List plus 10%
Chicago	List price	List price	List plus 20%	List price
New York	15% from list	List plus 10%	List plus 5%	10-2½% from list

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ½ and smaller	30%	45—5%	40%
Tinned	30%	45—5%	40%

Button heads, ½, ⅝, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.
New York...$5.675 Cleveland...$5.15 Chicago...$5.67 Pittsburgh...$4.65
Coneheads, same sizes:
New York...$5.775 Cleveland...$5.25 Chicago...$5.77 Pittsburgh...$4.75

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	52.00	40.00	45.00
Brass	49.00	38.00	42.00

For immediate stock shipment 3c. is usually added. The prices of course vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb. the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb., the advance is 5c. over base (100-lb. lots); for less than 50 lb. but not less than 25 lb., 10c should be added to the base price; and for quantities of from 10 to 25 lb. the extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet-metal mouldings if ordered in above quantities. The above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ½ up to 2 in. inclusive in rounds, and ½ up to 1½ in. inclusivein square and hexagon—all varying by thirty-seconds up to 1 in. and by sixteenths over 1 in. On all shipments aggregating less than 100 lb. there is usually a boxing charge of $1.50.

TIN PLATES—Warehouse prices per box:

Coke tin plate, 14 x 20:

	Cleveland		Chicago	
	Current	One Yr. Ago	Current	One Yr. Ago
100 lb	$9.17½	$12.00	$10.60	$11.75
I. C. 107 lb	9.42½	12.17½	10.70	11.90

Terne plate, 20 x 28:

Base Weight	Net Weight	Coating				
100 lb.	200	3	18.95	18.95	19.10	17.90
I. C.	214	8	19.25	19.25	19.40	18.25
I. C.	270	8	21.75	21.75	21.40	20.35
I. C.	218	12	21.75	21.75	22.60	19.25
I. C.	221	15	22.50	22.50	22.10	19.50
I. C.	226	30	23.25	23.25	22.60	20.50
I. C.	231	25	24.50	24.50	23.10	21.30
I. C.	236	30	25.75	25.75	23.60	22.25
I. C.	241	35	26.75	26.75	25.10	23.25
I. C.	246	40	28.00	28.00	25.60	24.55

NOTE—New York prices furnished on application to dealers. Price varies according to whether the plates are wanted for work essential to the war or for nonessential work.

COTTON WASTE—The following prices are in cents per pound:

	New York		Cleveland	Chicago
	Current	One Year Ago		
White	11.00 to 13.00	13.00	16.50	12.00 to 16.50
Colored mixed	8.50 to 12.00	12.00	13.00	11.50 to 14.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½ x 13½	13½ x 20½
Cleveland	52.00	58.00
Chicago	48.00	50.00

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$1.75	$1.75	$1.75
Philadelphia	1.75	1.75	1.75
Cleveland	2.40	2.40	2.10
Chicago	2.00	2.00	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$4.30	$4.30	$4.30
Cleveland	4.60	4.60	4.50
Chicago	4.50	4.00	3.80

COKE—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Oct. 31	Oct. 24	Oct. 17	Oct. 10	Oct. 3
Prompt furnace	$6.00	$6.00	$6.00	$6.00	$6.00
Prompt foundry	7.00	7.00	7.00	7.00	7.00

FIRE CLAY—The following prices prevail:

		Current
Chicago	450-lb. bbl.	$2.50
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels	$1.61	$1.20	$1.90	$1.25	$1.83	$1.18
5-gal. cans	1.76	1.30	2.00	1.40	2.03	1.28

WHITE AND RED LEAD in 500-lb. lots sells as follows in cents per pound:

	Red				White	
	Current		1 Year Ago		Current	1 Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100-lb. keg	14.00	14.50	12.25	12.50	14.00	12.50
25 and 50-lb. kegs	14.25	14.75	12.50	12.75	14.25	12.25
12½-lb. keg	14.50	15.00	12.75	13.00	14.50	12.50
5-lb. cans	....	.....	14.25	14.00	16.00	14.50
1-lb. cans	....	.....	14.25	14.50	17.00	14.50

NEW *and* ENLARGED SHOPS

Consult the Buying Section when in need of machinery or supplies

WASHINGTON, D. C.

The Navy aims to give information regarding its purchases to all manufacturers known to be in a position to supply its demand. Owing to the need of prompt action in the cases of all machine tools hereinafter listed, the Navy cannot arrange to permit a postponement of the opening of bids if the manufacturers are able to secure bidding forms and submit their bids prior to date fixed for opening.

In case time does not permit this, it will be appreciated if any manufacturer not receiving information directly regarding these purchases will notify the Purchasing Division, Bureau of Supplies & Accounts, Navy Department, Washington, D. C., in order that the firm's name may be properly listed for all future purchases.

The Bureau of Supplies and Accounts, Navy Dept., will soon receive bids for machines and machine tools as follows:

Schedule No. 6943½, 1 engine lathe, delivery San Diego, Cal.

Schedule No. 6980½, 2 emery grinders, delivery Brooklyn, N. Y.

Schedule No. 6985½, 1 double geared lathe, delivery Boston, Mass.

Schedule No. 6997½, 2 emery grinders, delivery Brooklyn, N. Y.

Schedule No. 6998½, miscellaneous machine tools, delivery Charleston, S. C.

Schedule No. 7011½, 6 milling machines, delivery Washington, D. C.

Schedule No. 7012½, 1 milling machine, delivery Alexandria, Va.

Schedule No. 7052½, 1 power hacksaw, delivery Philadelphia, Penn.

Schedule No. 7063½, 1 lathe and tools, delivery Great Lakes, Ill.

Schedule No. 7065½, 1 precision lathe, delivery San Diego, Cal.

Schedule No. 7074½, 1 universal saw and hand planer and joints, delivery submarine base, New London, Conn.

Schedule No. 7075½, generator and gasoline engine, delivery Pensacola, Fla.

Schedule No. 7076½, 100 pneumatic drills, delivery Norfolk, Va.

Schedule No. 7099½, 2 pipe cut machines, delivery Boston, Mass.

The Bureau of Supplies and Accounts, Navy Dept., will receive bids until Nov. 25, furnishing and delivering machines and machine tools as follows:

Schedule No. 7017½, 1 single surface planer and 2 bench band saws, delivery Boston, Mass.

Schedule No. 7028½, 2 automatic shapers, delivery Puget Sound (Bremerton P. O.) Wash.

Schedule No. 7043½, 1 lapping machine, delivery Boston, Mass.

METAL WORKING

NEW ENGLAND STATES

Conn., Durham—The Merriam Manufacturing Co., manufacturer of tin boxes, plans to rebuild its factory which was recently destroyed by fire. Estimated cost, $40,000.

Conn., Hartford—The Bennett Metal Treating Co., New Britain Ave., Elmwood, has awarded the contract for the erection of a 2-story, 36 x 70 ft. machine shop. Estimated cost, $15,000.

Conn., New Britain—The North and Judd Manufacturing Co., Stanley and East Main St., has had plans prepared by M. L. Unkelbach, archt., for the erection of a new garage.

Conn., New Haven—The New England Wire Machine Co., Stiles St., has awarded the contract for altering and improving its plant.

Conn., New Haven—The New York, New Haven & Hartford R. R. has awarded the contract for the erection of a 1-story, 422 x 126 ft. locomotive repair shop here. Estimated cost, $12,000. E. Gagie, New Haven, Ch. Engr.

Mass., Boston—The Bureau of Yards & Docks, Navy Dept., Wash., D. C., has awarded the contract for extensions and alterations to machine shop building No. 42. Estimated cost, $617,122.

MIDDLE ATLANTIC STATES

Del., Newcastle—The American Manganese Steel Co. has awarded the contract for the erection of a 1-story, 50 x 50 ft. addition to its factory. Noted Sept. 19.

Del., Wilmington—The American Car and Foundry Co., foot of East 8th St., plans to build a machine shop. Estimated cost, $30,000.

Md., Baltimore—A. Wilford, Sr., 1413 Haubert St., purchased a factory on East Fort Ave., and plans to re-equip same for a machine shop.

Md., Highlandtown (Baltimore P. O.)—The Continental Can Co., Inc., 1002 Keyser Bldg., Baltimore, has awarded the contract for the erection of a 2-story addition to its plant here on 1st Ave. and Clinton St. Estimated cost, $10,000.

N. J., Boonton—The Radium Luminous Material Corporation plans to build a new addition to its plant.

N. J., Garwood—The National Boiler Co., South Ave., has had plans prepared by Hooper & Co., Arch., 116 Market St., Newark, for the erection of a 1-story, 100 x 105 ft. foundry addition to its plant.

N. J., Hoboken—Fire recently destroyed a portion of the plant of the F. J. Rooney Lamp Co., Willow Ave. and 13th St. Loss, $10,000.

N. J., Jersey City—The Erie R. R. has had plans prepared for the erection of an addition to its locomotive shops on Pavonia Ave. G. B. Owens, New York City, Ch. Engr.

N. Y., Buffalo—The Atterbury Motor Car Co., Elmwood and Hertel Ave., has had plans prepared for the erection of an addition to its plant. J. R. Spraker, Gen. Mgr. Noted Feb. 14.

N. Y., Buffalo—The Buffalo Dry Dock Co., Ganson St., has had plans prepared by C. C. Hauck, Arch., for a 2-story, 70 x 150 ft. addition to its punch shop. Estimated cost, $20,000. Noted Nov. 14.

N. Y., Gloversville—The Hudson Woodenware Co. is considering plans for the erection of a new plant.

N. Y., Hempstead—Syndicate headed by M. F. Bramley, Arcade, Cleveland, Ohio, has purchased a 33 acre site, here, and plans to build a factory for the manufacture of aeroplanes.

N. Y., Jamestown — The T. J. Clark Paper Box and Label Co. has had plans prepared for the erection of a 22-story, 40 x 50 ft. addition to its plant.

N. Y., New York (Borough of Brooklyn)—The Atlantic Basin Iron Works, Summit St., manufacturer of machinery, has awarded the contract for a 2-story, 62 x 210 ft. forge shop, to be erected on Imlay and Bowne St. Estimated cost, $30,000. Noted Sept. 26.

N. Y., New York (Borough of Brooklyn)—The Lion Match Co., 91 Grand St., New York City, has leased a site here, at 1574-76 Pacific St., and plans to build plant.

N. Y., New York (Borough of Manhattan)—The Metal Disintegrating Co., 3 South William St., is having plans prepared for the erection of four 2-story, 200 x 400 ft. factory buildings to replace those recently destroyed by fire.

N. Y., New York (Borough of Manhattan)—The Milliken Bros. Manufacturing Co., Woolworth Bldg., has purchased the plant of J. H. Young Stone Co. and site adjoining on 136th St. and East River, for the establishment of a galvanizing plant. Equipment, including shears, punches, hoists, cranes, etc., will be installed in same. Estimated cost, $25,000. J. E. Jennings, Vice Pres.

N. Y., New York—(Borough of Queens)—Brewster & Co., Bridge Plaza and Prospect St., Long Island City, is altering its 5-story, automobile manufacturing plant. Estimated cost, $35,000.

N. Y., New York (Borough of Queens)—The Empire Art Metal Co., College Point, is having preliminary plans prepared for the erection of a 2-story addition to its plant. Address A. C. Tonnell.

N. Y., New York—(Borough of Queens)—W. H. Gahagen, 147 Remsen St., Brooklyn, is in the market for an 18-20 ft. bending roll machine to be installed in its proposed factory on Somerville Harbor and Jamaica Bay, Long Island City. Estimated cost, between $15,000 and $20,000.

N. Y., New York—(Borough of Richmond)—The Standard Shipbuilding Corporation, Shooters Island, is in the market for a used set of horizontal rolls, top roll to be 11 or 12 in. diameter and 14 ft. long, capacity to be ¾ in. plate full length of machine.

Penn., Chester—Fire recently destroyed a portion of the plant of the Chester Steel Casting Co., 7th and Broomall St. Loss between $10,000 and $15,000.

Penn., Cleona—Fire recently destroyed the fiber broom manufacturing plant of I. C. Imboden. Loss, $20,000.

Penn., Irvine—The National Forge and Tool Co. is building a new 1-story, 40 x 60 ft. forge shop addition to its plant. Noted Oct. 3.

Penn., Jessup—The Du Pont Powder Co., Du Pont Bldg., Wilmington, Del., plans to build a new powder mill here. C. K. Weston, Wilmington, Del., Publicity Agent.

Penn., Philadelphia—The Department of Public Safety has had plans prepared for the erection of a repair shop on 11th and Reed St.

Penn., Philadelphia—J. M. Kennedy, 10th and Chestnut St., is building a 1-story, 70 x 105 ft. machine shop on South Venango and West Hope St. Estimated cost, $7000.

Penn., Philadelphia (Nicetown) — The Midvale Steel and Ordnance Co., Widener Bldg., Philadelphia, has had revised plans